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The Mineral Industry of Japan

UNITED STATES DEPARTMENT OF THE INTERIOR

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The Mineral Industry of Japan

By John C. Wu[1]

The mining sector of Japan's mineral industry continued to suffer from high production costs, depleting ore reserves, and increased imports of low-priced minerals and metals resulting from further appreciation of the Japanese yen in 1987. According to the Ministry of International Trade and Industry (MITI), the output of the mining industry declined 9% from that of 1986 because of fewer operating mines.

The number of operating mines for metals and industrial minerals declined to 34 and 598 from 52 and 608, respectively, in 1986. The number of employees in metals and industrial minerals mines decreased to 3,579 and 14,088 from 7,743 and 14,891, respectively, in 1986.[2] The following mines were closed in 1987: February, the Hosokura lead-zinc mine in Miyagi by Hosokura Mining Co. Ltd.; March, the Akenobe copper-tin-zinc mine in Hyogo by Akenobe Mining Co. Ltd., and the Syakanai copper-lead-zinc mine in Akita by Syakanai Mining Co. Ltd.; and September, the Nakatatsu lead-zinc mine in Fukui by Nippon Zinc Mining Co. Ltd.

Despite reduced output of domestic ore, production of most nonferrous metals, except zinc, increased by importing more raw materials to meet a stronger domestic demand. Zinc production failed to rebound owing to a substantial decline in domestic output of zinc ore. Production of primary aluminum dropped to a new low since 1952 because of increased imports. Production of iron and steel increased slightly despite a further decline in exports and increased imports in 1987.

A construction boom stimulated by public works projects in the second half of 1987 not only created a stronger domestic demand for steel and nonferrous metals but also helped the mineral processing sector from further decline. Because of stronger domestic demand and increased domestic prices of iron and steel products and nonferrous metals, most steelmakers and nonferrous metal producers reportedly returned to a profitable position and delayed further reductions of production facilities and employment.

In the industrial minerals sector, production of limestone rebounded because of increased construction. However, cement production failed to recover due to a further decline in exports and increased imports of low-priced foreign cement. The cement industry is expected to scale down its annual capacity by 12 million tons to 86 million tons to survive keen competition from the Republic of Korea and Taiwan. The nitrogen fertilizer industry continued to scrap its excess capacity. Production of urea declined considerably because of low price and increased imports.

In the mineral fuels sector, Japan's coal output dropped to a historical low. In line with the Eighth National Coal Policy, the Sunagawa Mine in Hokkaido was closed permanently in July by Mitsui Coal Mining Co. Ltd. and the Mayachi Mine, also in Hokkaido, in October by Hokutan Mayachi Coal Mining Co. Ltd. Other major coal producers also cut back production and employment. As a result, the number of employees in the coal mining industry decreased to 9,167 from 12,906 in 1986. In petroleum refining, the industry continued to scale down its facilities for producing heavy fuel oil. It was expected to upgrade and modernize production facilities for higher value-added products.

In 1987, Japan was the world's largest producer of cadmium metal, iodine, and

selenium metal; the second largest producer of indium, gallium, steel, and zinc metals; the third largest producer of refined copper, limestone, refined nickel, and titanium sponge metal. Japan remained the world's largest importer of coal, copper concentrate, iron ore, nickel ore, liquefied natural gas (LNG), phosphate rock, and industrial salt. Japan was the world's second largest importer and consumer of crude petroleum.

Despite the adverse effect of further appreciation of the yen on growth of the export-oriented economy, the Japanese economy grew 4.2% compared with 2.4% (revised) in 1986. According to the Economic Planning Agency, the higher growth in 1987 was attributed mainly to an expansion in domestic demand spurred by the implementation of a $41.5 billion[3] Government spending package to stimulate the economy. Private housing starts, public-works spending, and corporate investment in plant and equipment all showed a sharp increase in 1987. As a result of the 4.2% rise in the output of goods and services, Japan's gross national product (GNP) in 1980 constant dollars reached $2,154 billion and per-capita GNP rose to $19,642. In 1987, per-capita GNP of the United States was $18,403.

The impact of the Japanese yen on merchandise trade continued to show a decline in exports and a rise in imports in volume terms. However, because of a 14% yen appreciation in 1987, exports rose to $229 billion from $209 billion in 1986, while imports increased to $149 billion from $126 billion in 1986. As a result, Japan's merchandise trade surplus declined only 3.6% to $80 billion in 1987.

Government Policies and Programs.—To expand domestic demand and reduce the external trade surplus, the Government adopted a package of "Emergency Economic Measures" in May. The $41.5 billion package included $22.5 billion for Central Government investment projects, $1.7 billion for public-enterprise investment, $5.5 billion for local government public works, $7 billion for income tax reduction, and $4.8 billion of additional funding in public lending for housing construction. Most funding for the package reportedly will come from selling the Government's share of Nippon Telegraph and Telephone, to be carried out over a 4-year period beginning in 1987, and issuing Government bonds.

In July, the Metal Mining Agency of Japan (MMAJ) announced that a final agreement was reached between Japan and China for joint exploration and feasibility studies for 15 rare metal minerals in China over a 5-year period beginning in August 1987. The joint project included geological surveys, physical prospecting, core sampling, and exploratory drilling in northwest Heilongjiang Province near Harbin for chromium, cobalt, copper, lead, molybdenum, nickel, silver, and vanadium and along the coast of Leizhou Peninsula near Yangjiang in southwest Guangdong Province for columbium, hafnium, rare earths, tantalum, titanium, and zirconium. Funding for the $17 million project was provided by the Japan International Cooperation Agency.[4]

Japan's stockpile of chromium, cobalt, manganese, molybdenum, nickel, tungsten, and vanadium reached 31.4-day supply by the end of its fiscal year 1987. In 1987, MMAJ, the administrator of the stockpile program, changed the three-facet stockpile program to two, national and private, to reduce Government expenditures and allow more private companies to participate. Under this new program, MMAJ continued to administer the national program for maintaining national economic stability in the event of a medium- or long-term supply disruption. The Japan Rare Metal Association managed the private program for maintaining market stability in the event of short term supply disruptions. At the end of fiscal year 1987, the national stockpile had a 22-day supply and the private stockpile had a 9.4-day supply.

PRODUCTION

Mine production of most nonfuel minerals was substantially lower because of closing more major nonferrous mines in early 1987 resulting from appreciation of the yen. Mine output of bentonite, copper, dolomite, fire clay, gold, iron ore, lead, silver, tin, tungsten, and zinc all declined resulting from the mine closures or further production cutbacks. Japan stopped production of tin ore in March when the mine at Akenobe in Hyogo Prefecture was shut down permanently.

Japan's coal output declined to another historical low level in 1987 because of further mine closures and production cutbacks by major coal mining companies. Following implementation of the Eighth National Coal Policy in April, 2 of 11 remaining major coal mines were shut down permanently in Hokkaido. The coal industry was expected to reduce its coal production to 10 million tons in 1991.

In the mineral processing sector, production of primary aluminum, bismuth, cadmium, cobalt, lead, titanium sponge, and zinc declined because of high production costs, shortages of raw materials, or reduced exports due to the higher yen value. However, metal production of copper, gold, indium, rare-earth metals, selenium, silver, and steel increased due mainly to strong domestic demand. Production of cement, fertilizer materials, and refined petroleum products declined because of reduced capacity and increased imports due to the higher yen.

Table 1.—Japan: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986	1987[p]
METALS					
Aluminum:					
Alumina, gross weight thousand tons	1,065	1,172	978	607	358
Metal:					
Primary:					
Regular grades do.	256	287	227	140	41
High-purity do.	3	4	5	8	12
Secondary do.	802	819	861	876	894
Antimony:					
Oxide	7,596	9,698	8,243	9,877	9,805
Metal	273	253	296	194	196
Arsenic, white (equivalent of arsenic acid)[e]	300	500	500	500	500
Bismuth	573	563	642	640	546
Cadmium	2,214	2,423	2,535	2,489	2,450
Chromium:					
Chromite, gross weight	8,396	7,420	11,925	10,642	11,815
Metal	2,786	3,452	[r]3,557	2,987	[e]3,200
Cobalt metal	1,871	905	1,277	1,338	124
Columbium and tantalum: Tantalum metal[e]	40	45	45	44	44
Copper:					
Mine output, Cu content	46,045	43,309	43,208	34,924	23,817
Metal:					
Blister and anode:					
Primary	944,600	821,100	802,300	827,700	871,000
Secondary	117,300	107,900	130,300	124,400	97,700
Total	1,061,900	929,000	932,600	952,100	968,700
Refined:					
Primary	944,551	821,064	802,341	827,657	870,994
Secondary	147,378	114,092	133,636	115,380	109,355
Total	1,091,929	935,156	935,977	943,037	980,349
Gallium metal:					
Primary	3	10	10	10	10
Secondary	5	7	10	9	10
Germanium:					
Oxide	11	11	14	14	14
Metal	7	8	10	9	5
Gold:					
Mine output, Au content thousand troy ounces	101	104	171	331	276
Metal do.	1,296	1,342	1,383	1,575	1,802
Indium metal do.	[r]450	482	514	579	875
Iron and steel:					
Iron ore and iron sand concentrate:					
Gross weight thousand tons	298	324	338	292	266
Fe content do.	185	202	212	182	166
Roasted pyrite concentrate (50% or more Fe) do.	329	225	218	205	210
Metal:					
Pig iron and blast furnace ferroalloys do.	72,936	80,403	80,569	74,651	73,352

See footnotes at end of table.

Table 1.—Japan: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986	1987[p]
METALS —Continued					
Iron and steel —Continued					
Metal —Continued					
Electric-furnace ferroalloys:					
Ferrochrome	304,053	323,930	349,496	286,925	272,298
Ferromanganese	389,381	485,008	441,703	359,044	332,286
Ferronickel	180,826	217,053	227,043	200,311	203,143
Ferrosilicon	157,939	153,386	150,167	107,236	73,706
Silicomanganese	222,204	233,061	216,916	148,429	91,806
Ferrochromium-silicon[2]	7,152	6,451	9,463	6,377	8,310
Other:					
Calcium silicon	2,357	1,724	2,496	2,005	1,419
Ferrocolumbium	530	1,031	1,072	862	[r]714
Ferromolybdenum	3,104	3,299	3,143	1,894	2,402
Ferrotungsten	200	144	114	122	96
Ferrovanadium	2,821	3,733	3,353	2,867	2,629
Unspecified	2,159	2,727	2,575	2,015	1,384
Total[3]	1,272,726	1,431,547	1,407,541	1,118,087	989,923
Steel, crude thousand tons	97,179	105,586	105,279	98,275	99,513
Semimanufactures, hot-rolled:					
Of ordinary steels do.	77,552	82,765	82,731	78,136	78,231
Of special steels do.	13,286	16,070	16,802	15,004	15,069
Lead:					
Mine output, Pb content	46,888	48,735	49,951	40,327	37,870
Metal, refined:					
Primary	203,325	233,816	233,706	232,732	218,770
Secondary	118,317	129,179	133,257	128,860	119,700
Magnesium metal:					
Primary	6,026	7,103	8,458	8,116	8,180
Secondary	13,012	15,656	20,894	13,400	10,300
Manganese:					
Ore and concentrate:					
Gross weight	75,199	61,635	21,140	5,905	
Mn content	19,860	16,679	5,562	1,535	
Oxide	47,182	47,807	49,081	57,159	66,731
Metal	3,939	4,323	[r]4,646	3,854	[e]3,700
Molybdenum:					
Mo content of concentrate[e]	97	147	98		
Metal	438	493	565	586	624
Nickel metal:					
Refined	23,812	23,356	23,257	24,681	22,896
Ni content of nickel oxide sinter	12,600	15,150	[r]15,200	18,900	22,425
Ni content of ferronickel	45,739	50,842	54,235	49,169	49,405
Total	82,151	89,348	[r]92,692	92,750	94,726
Platinum-group metals:					
Palladium metal troy ounces	37,122	33,802	43,703	46,699	45,568
Platinum metal do.	21,460	19,523	22,216	21,312	24,202
Rare-earth oxide[4]					3,053
Selenium, elemental	433	465	497	427	481
Silicon, high purity 652	908	1,471	2,094	1,671	
Silver:					
Mine output, Ag content thousand troy ounces	9,877	10,403	10,915	11,294	9,035
Metal, primary do.	48,794	50,952	52,817	55,448	59,228
Tellurium, elemental	55	65	66	56	53
Tin:					
Mine output, Sn content	600	485	510	500	86
Metal, smelter	1,260	1,354	1,391	1,280	895
Titanium:					
Metal	10,590	18,368	21,897	14,481	10,083
Oxide	195,889	204,665	217,695	222,941	238,929
Tungsten:					
Mine output, W content	475	477	568	579	259
Metal	1,842	2,386	2,638	2,557	2,713
Uranium metal kilograms	4,000	4,000	5,000	5,000	5,000
Vanadium metal:[5] Secondary	706	700	762	843	[e]840
Zinc:					
Mine output, Zn content	255,712	252,700	253,021	222,071	165,675
Oxide	64,796	72,794	72,832	68,277	73,434
Metal:					
Primary	579,021	644,360	629,504	626,489	591,516
Secondary	171,016	162,317	160,652	127,291	115,847

See footnotes at end of table.

Table 1.—Japan: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986	1987[p]
METALS —Continued					
Zirconium:					
Metal[e]	45	45	45	45	45
Oxide	4,900	6,250	[r]6,700	[r]6,700	[r]6,700
INDUSTRIAL MINERALS					
Asbestos	1,490	3,100	2,971	3,593	3,143
Barite	69,699	66,018	76,997	52,848	31,625
Bromine, elemental[e]	12,000	12,000	12,000	15,000	15,000
Cement, hydraulic thousand tons	80,892	78,859	72,845	71,261	[r]70,000
Clays:					
Bentonite	440,923	410,079	461,530	408,864	415,806
Fire clay	1,260,678	1,423,235	1,148,196	1,004,150	907,342
Kaolin	230,720	224,614	221,996	203,655	158,973
Feldspar and related materials:					
Feldspar	30,996	35,526	30,895	32,063	33,754
Aplite	491,286	441,005	469,386	457,375	466,479
Gypsum thousand tons	5,845	[r]6,050	[r]6,300	[r]6,400	[r]6,000
Iodine, elemental	7,273	7,302	7,251	7,389	7,014
Lime: Quicklime thousand tons	7,436	7,753	7,454	6,717	6,745
Nitrogen: N content of ammonia do.	1,545	1,668	1,628	1,568	1,556
Perlite[e]	75,000	75,000	75,000	75,000	75,000
Salt, all types thousand tons	921	955	1,290	1,370	1,397
Sodium compounds, n.e.s.:					
Carbonate	1,103,378	1,036,133	1,057,102	1,020,869	1,098,465
Sulfate	260,661	278,941	276,814	253,450	255,313
Stone, crushed and broken:					
Dolomite thousand tons	4,386	4,268	4,329	3,953	3,834
Limestone do.	169,780	169,825	164,156	162,358	165,957
Sulfur:					
S content of pyrite do.	272	259	253	158	79
Byproduct:					
Of metallurgy do.	1,239	1,191	1,201	1,228	[r]1,220
Of petroleum do.	1,102	1,142	1,044	985	[r]930
Talc and related materials:					
Talc	87,124	84,532	78,616	63,851	53,927
Pyrophyllite	1,378,699	1,414,424	1,355,625	1,270,112	1,241,069
Vermiculite[e]	17,000	17,000	17,000	17,000	17,000
MINERAL FUELS AND RELATED MATERIALS					
Carbon black thousand tons	568	602	632	616	629
Coal:					
Anthracite do.	17	23	28	13	10
Bituminous[e] do.	17,045	16,622	16,357	15,999	13,039
Total do.	17,062	16,645	16,383	16,012	13,049
Coke including breeze:					
Metallurgical do.	43,600	48,145	48,622	45,132	43,717
Gashouse including breeze do.	3,073	3,130	3,120	3,006	2,716
Fuel briquets, all grades do.	282	306	315	241	200
Gas, natural:					
Gross[e] million cubic feet	73,645	75,293	78,562	74,351	76,553
Marketed do.	68,957	71,329	80,122	77,959	83,060
Natural gas liquids:					
Natural gasoline thousand 42-gallon barrels	55	53	57	56	57
Liquefied petroleum gas from natural gas (field plants only)[e] do.	300	300	300	300	300
Peat[e]	60	60	60	60	60
Petroleum:					
Crude thousand 42-gallon barrels	3,666	2,962	3,929	4,629	4,453
Refinery products:					
Gasoline:					
Aviation do.	62	98	75	82	57
Other do.	223,590	227,678	215,514	214,866	216,136
Jet fuel do.	27,933	23,499	27,229	25,295	25,348
Kerosene do.	168,982	168,774	152,477	151,494	126,003
Distillate fuel oil do.	144,936	155,817	147,596	164,308	158,685
Residual fuel oil do.	485,258	479,836	408,655	386,452	371,659
Lubricants do.	11,517	12,032	12,133	11,730	12,271
Asphalt and bitumen do.	29,682	30,719	29,814	33,418	34,436
Liquefied petroleum gas do.	48,733	47,029	50,243	44,010	45,029
Naphtha do.	72,509	73,175	65,093	60,822	55,250

See footnotes at end of table.

Table 1.—Japan: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1983	1984	1985	1986	1987[p]
MINERAL FUELS AND RELATED MATERIALS —Continued						
Petroleum —Continued						
Refinery products —Continued						
Paraffin	do.	981	1,050	994	[e]980	[e]900
Petroleum coke	do.	717	881	1,088	956	824
Unfinished oils	do.	4,478	48,243	39,525	40,928	43,161
Refinery fuel and losses	do.	88,591	[r]133,666	[r]153,968	[r]136,458	[r]140,464
Total	do.	1,307,989	1,399,487	1,304,404	[r]1,271,779	[r]1,237,223

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through Sept. 6, 1988.

[2]For reasons not evident in sources, these figures are reported as negative numbers. (See also footnote 3.)

[3]Sum of listed detail as reported, but adding quantity bearing footnote 2 as positive numbers. Japanese sources provide the following totals for ferroalloy output in the years indicated, in metric tons: 1983—1,258,422; 1984—1,418,645; 1985—1,388,615; 1986—1,105,333; and 1987—973,303. These totals represent the sum of listed detail using the quantities bearing footnote 2 as negative numbers, thereby not only omitting the footnoted numbers, but actually subtracting them from the sum of all other alloys. The reason for this procedure in source publications is not explained.

[4]Includes oxide of cerium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, terbium, yttrium, and neodymium fluoride.

[5]Represents metal content of vanadium pentoxide recovered from petroleum residues, ashes, and spent catalysts.

[6]Includes coking coal and steam coal.

[7]Includes output from gas wells and coal mines.

[8]May include some additional unfinished oils.

TRADE

Despite a decrease in volume of exports and a substantial increase in imports, Japan's merchandise trade surplus remained high at $80 billion compared with $83 billion in 1986 principally because of an additional 14% appreciation of the yen on the U.S. dollar-based export commodities in 1987. Export earnings rose 9.6% to $229 billion while imports surged 18% to $149 billion. The Japanese bilateral trade surplus with the United States remained at $52.2 billion in 1987. Exports to the United States rose 13.6% to $83.6 billion, while imports from the United States increased only 4.9% to $ 31.4 billion.[8]

Major export commodities such as motor vehicles, office equipment, tape recorders, chemicals, scientific and optical equipment, thermionic products, metal-working and power-generating machinery, and radio and TV receivers, with the exception of iron and steel products, continued to grow and contributed most to the increased export earnings in 1987. Foodstuff and raw materials such as mineral fuels, iron ore, nonferrous metal ore, and iron and steel scrap, chemicals, and nonferrous metals remained major import commodities. However, there were substantial increases in imports of chemicals, nonferrous metal ore and products and refined petroleum products, reflecting further openings in the Japanese market for foreign goods.

In 1987, imports of mineral fuels included $20 billion of crude and partially refined petroleum, $7 billion of refined petroleum products, and $5 billion of coal. Imports of nonfuel minerals and metals included $6 billion of nonferrous metals, $2 billion of iron ore, $2 billion of nonferrous metal ore, and $250 million of iron and steel scrap. Exports of minerals and metals included $13 billion of iron and steel products, $5 billion of nonferrous metals, and $3 billion of industrial mineral products.

The United States remained the most important trade partner of Japan, accounting for 36% of Japan's exports and 21% of Japan's imports. In mineral trade, the United States remained a major supplier of aluminum, beryllium, coal, copper, gold, kaolin, magnesium, molybdenum, petroleum coke, phosphate rock, refined petroleum products, rare earths, silver, and precious and semiprecious stones. Japan remained a major supplier of aluminum and copper semimanufactures, iodine, iron and steel products, iron oxide, manganese oxide, titanium sponge, and titanium mill products in 1987. Other major mineral trade partners of Japan included Australia, Brazil, Canada, Chile, India, Indonesia, the Republic of Korea, Malaysia, Mexico, New Caledonia, Papua New Guinea, Peru, the Philippines, Saudi Arabia, the Republic of Korea, the Republic of South Africa, and the United Arab Emirates. Among these raw material suppliers, Japan displaced the United States and became the leading trade partner of the Republic of South Africa in 1987 because of the U.S. sanction against the Republic of South Africa.

Table 2.—Japan: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	292	231	1	Republic of Korea 87; Taiwan 73; India 62.
Aluminum:				
Ore and concentrate	340	429		All to Republic of Korea.
Oxides and hydroxides	481,536	384,473	4,245	Canada 242,704; Republic of Korea 46,075; Indonesia 25,158.
Metal including alloys:				
Scrap	2,317	1,914	35	Taiwan 1,205; Republic of Korea 598.
Unwrought	2,229	2,021	279	Republic of Korea 590; Thailand 314; Burma 262.
Semimanufactures	246,130	225,463	142,830	Republic of Korea 13,120; Taiwan 12,480; China 11,595.
Antimony: Metal including alloys, all forms	6	2	—	Mainly to Canada.
Beryllium: Metal including alloys, all forms kilograms	109	811	—	Republic of Korea 639; India 150; Taiwan 22.
Bismuth: Metal including alloys, all forms	230	257	66	Netherlands 112; China 37.
Cadmium: Metal including alloys, all forms	382	452	(2)	East Germany 184; Netherlands 144; United Kingdom 55.
Chromium:				
Ore and concentrate	756	283	—	Republic of Korea 199; Indonesia 41.
Oxides and hydroxides	3,247	3,990	635	Taiwan 1,320; Republic of Korea 1,061.
Cobalt: Oxides and hydroxides	12	24	1	Taiwan 9; Republic of Korea 6; Vietnam 3.
Columbium and tantalum: Metal including alloys, all forms, tantalum	12	11	1	China 4; Austria 2; West Germany 2.
Copper:				
Ore and concentrate	—	1,684	—	North Korea 1,149; Sweden 535.
Sulfate	508	603	2	Taiwan 488; Republic of Korea 73; United Kingdom 17.
Metal including alloys:				
Scrap	51,591	65,944	20	Taiwan 23,572; China 16,473; Republic of Korea 14,322.
Unwrought	7,559	24,295	17	Republic of Korea 15,757; Philippines 3,263; Belgium-Luxembourg 3,000.
Semimanufactures	193,882	209,191	44,463	Taiwan 37,600; China 19,184; Republic of Korea 11,295.
Gold:				
Waste and sweepings value, thousands	—	$4	—	All to Taiwan.
Metal including alloys, unwrought and partly wrought troy ounces	143,497	187,324	6,144	Singapore 93,961; Republic of Korea 33,833; Taiwan 19,481.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	17	108	50	Taiwan 40; China 12.
Pyrite, roasted	—	5	—	All to Republic of Korea.
Metal:				
Scrap	165,636	461,048	17	China 244,582; Taiwan 94,412; Republic of Korea 89,463.
Pig iron, cast iron, related materials thousand tons	1,085	1,074	6	China 713; Republic of Korea 192.
Ferroalloys:				
Ferrochromium	5,468	3,433	884	India 996; North Korea 567; Australia 517.
Ferromanganese	25,988	6,857	34	Cuba 1,313; Republic of Korea 956; Australia 889.
Ferronickel	4,475	7,100	—	All to Netherlands.
Ferrosilicomanganese	170	16	—	Taiwan 14.
Ferrosilicon	913	1,091	—	Taiwan 485; Republic of Korea 342.
Unspecified	2,077	3,246	275	Republic of Korea 1,875; Taiwan 629.
Steel, primary forms thousand tons	3,168	2,979	266	Republic of Korea 958; China 617.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS —Continued				
Iron and steel —Continued				
Metal —Continued				
Semimanufactures:				
Bars, rods, angles, shapes, sections thousand tons	7,844	6,417	779	China 2,945; Taiwan 395; Republic of Korea 335.
Universals, plates, sheets do.	12,554	11,870	1,959	China 3,401; Taiwan 759; Republic of Korea 683.
Hoop and strip do.	588	620	90	China 174; Taiwan 62; Hong Kong 46.
Rails and accessories do.	361	246	65	China 83; Canada 46.
Wire do.	317	302	95	China 60; Taiwan 16.
Tubes, pipes, fittings do.	6,871	5,692	462	U.S.S.R. 2,065; China 1,088; Iraq 202.
Castings and forgings, rough do.	23	20	11	Singapore 3; Taiwan 2.
Lead:				
Ore and concentrate	5,343			
Oxides	74	55	(2)	Vietnam 20; Taiwan 11; Republic of Korea 8.
Metal including alloys, all forms	29,711	28,761	58	Singapore 7,648; Republic of Korea 6,722; North Korea 6,491.
Magnesium: Metal including alloys, all forms	2,661	1,007	(2)	China 783; Taiwan 131; Singapore 33.
Manganese:				
Ore and concentrate	1,605	1,293		Philippines 726; Republic of Korea 298; Bangladesh 100.
Oxides	44,267	35,527	8,091	U.S.S.R. 5,200; Indonesia 5,148; West Germany 2,672.
Mercury 76-pound flasks	9,600	7,904	2,502	Netherlands 4,504; Thailand 312; Philippines 195.
Molybdenum: Metal including alloys, all forms	56	63	11	West Germany 14; Republic of Korea 12; Hungary 9.
Nickel: Metal including alloys, all forms	4,211	4,828	397	Taiwan 2,515; United Arab Emirates 1,007.
Platinum-group metals:				
Waste and sweepings value, thousands	$22	$1		Mainly to United Kingdom.
Metals including alloys, unwrought and partly wrought troy ounces	127,499	72,654	40,532	Taiwan 9,599; West Germany 8,617; Republic of Korea 5,244.
Selenium, elemental	273	171	30	United Kingdom 31; Netherlands 26; Taiwan 19.
Silver:				
Waste and sweepings value, thousands	$52	$92	$5	West Germany $47; Switzerland $17.
Metal including alloys, unwrought and partly wrought thousand troy ounces	3,003	2,031	17	Taiwan 796; Singapore 394; Republic of Korea 285.
Tin:				
Oxides	11	15	1	Taiwan 8; North Korea 2; Republic of Korea 1.
Metal including alloys, all forms	695	467	4	Republic of Korea 107; Taiwan 79; Hong Kong 73.
Titanium:				
Oxides	19,007	22,209	172	Taiwan 7,612; China 4,830; Republic of Korea 2,285.
Metal including alloys, all forms	7,330	6,143	2,116	France 683; United Kingdom 631; Sweden 484.
Tungsten: Metal including alloys, all forms	235	261	84	West Germany 59; Taiwan 40; Republic of Korea 25.
Uranium and/or thorium: Oxides and other compounds	428	406	18	Republic of Korea 173; Taiwan 74; United Kingdom 48.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS —Continued				
Zinc:				
Oxides	809	762	125	Taiwan 264; Thailand 107; Republic of Korea 97.
Metal including alloys, all forms	38,522	28,839	47	Taiwan 12,688; Republic of Korea 5,716; Philippines 5,244.
Other:				
Ores and concentrates	310	8,662	(2)	Sweden 5,250; Republic of Korea 3,585.
Ashes and residues	9,388	4,141	—	Taiwan 2,450; United Kingdom 530; Namibia 300.
Base metals including alloys, all forms	3,121	3,214	1,247	West Germany 511; U.S.S.R. 322; Republic of Korea 270.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc	11,845	11,624	1	Republic of Korea 4,858; Hong Kong 4,848; Taiwan 751.
Artificial:				
Corundum	19,235	20,904	510	Republic of Korea 10,602; Taiwan 3,079; Romania 1,200.
Silicon carbide	3,027	4,171	51	Republic of Korea 2,312; Taiwan 1,396; Australia 308.
Dust and powder of precious and semiprecious stones including diamond kilograms	2,226	4,352	758	Taiwan 1,669; West Germany 1,108; China 598.
Grinding and polishing wheels and stones	9,482	7,147	1,347	Hong Kong 828; Republic of Korea 774; U.S.S.R. 760.
Asbestos, crude	292	163	—	Republic of Korea 108; Taiwan 23.
Barite and witherite	13	—	—	—
Boron materials:				
Crude natural borates	2,190	1,405	—	Taiwan 1,240; Republic of Korea 160.
Oxides and acids	188	159	1	Republic of Korea 122; Taiwan 25.
Cement thousand tons	9,130	5,617	838	Hong Kong 1,788; Saudi Arabia 1,243; Singapore 701.
Clays, crude	63,554	64,931	2	Taiwan 36,931; Republic of Korea 13,129; Iraq 4,216.
Cryolite and chiolite	24	10	—	All to Republic of Korea.
Diamond:				
Gem, not set or strung carats	1,192	15,513	4,659	Republic of Korea 7,400; Singapore 1,545; Hong Kong 1,108.
Industrial stones do.	4,694	89,188	—	Republic of Korea 71,128; Italy 9,000; Australia 5,000.
Diatomite and other infusorial earth	2,599	1,506	4	Thailand 470; Taiwan 296; Australia 281.
Feldspar	27,646	32,822	—	Taiwan 30,323; Indonesia 1,015; Republic of Korea 702.
Fertilizer materials:				
Crude, n.e.s.	344	557	—	North Korea 298; Taiwan 253.
Manufactured:				
Ammonia	2,137	393	—	Thailand 212; Malaysia 67; Republic of Korea 44.
Nitrogenous	739,909	717,616	7,456	Thailand 265,179; Philippines 125,828; Malaysia 109,119.
Phosphatic	3,659	30,050	—	Burma 27,661; Sudan 700; Yemen (Sanaa) 698.
Potassic	82	310	—	Philippines 184; Somalia 110.
Unspecified and mixed	150,918	123,621	1,435	Thailand 50,000; Sri Lanka 13,620; Philippines 10,300.
Fluorspar	157	157	—	Taiwan 94; Philippines 35.
Graphite, natural	2,553	2,666	229	Republic of Korea 1,051; Taiwan 499; Czechoslovakia 248.
Gypsum and plaster	6,142	4,837	5	Taiwan 1,513; Indonesia 1,154; Malaysia 789.
Iodine including bromine and fluorine	6,605	6,641	1,902	United Kingdom 1,129; West Germany 864; France 636.
Kyanite and related materials	11,946	12,473	371	Republic of Korea 5,751; Taiwan 3,428; Indonesia 2,032.
Lime	34,219	7,842	(2)	Papua New Guinea 5,034; Indonesia 2,000; Hong Kong 367.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS —Continued				
Magnesium compounds: Oxides and hydroxides	108,776	126,613	29,751	Republic of Korea 34,944; Australia 13,285; Netherlands 10,072.
Mica, all forms	1,159	1,310	50	Hong Kong 368; Taiwan 322; Republic of Korea 243.
Nitrates, crude	15			
Phosphorus, elemental	301	167	5	Indonesia 51; Taiwan 26; United Kingdom 23.
Pigments, mineral:				
Natural, crude	33	51	1	Republic of Korea 32; Taiwan 16.
Iron oxides and hydroxides, processed	15,025	18,587	1,401	Taiwan 6,485; Republic of Korea 5,540; U.S.S.R. 910.
Precious and semiprecious stones other than diamond:				
Natual kilograms	25,159	28,121	82	India 11,846; Republic of Korea 10,656; Hong Kong 3,173.
Synthetic do.	67,580	114,461	22,768	Malaysia 20,661; Republic of Korea 16,387; Taiwan 16,386.
Pyrite, unroasted	248	472		Australia 400.
Salt and brine	1,414	1,182	312	North Korea 296; Caroline, Marianas, and Marshall Islands 138; Malaysia 101.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	64,865	81,968	8	China 37,245; Philippines 18,900; Indonesia 15,462.
Sulfate, manufactured	6,138	5,593	--	Republic of Korea 3,381; Thailand 1,235; Indonesia 801.
Stone, sand and gravel:				
Dimension stone:				
Crude and prtly worked	405	528		Republic of Korea 790.
Worked	8,581	1,506	121	Singapore 932; Republic of Korea 226.
Dolomite, chiefly refractory-grade	5,704	1,883	--	Indonesia 1,356; Taiwan 280; Republic of Korea 240.
Gravel and crushed rock	186,445	87,916	62	Australia 87,000; Republic of Korea 346; Iraq 147.
Limestone other than dimension	1,041,283	1,153,977	570	India 99,060; Singapore 27,134; Republic of Korea 22,127.
Quartz and quartzite	267	518	20	Malaysia 196; Taiwan 118; Republic of Korea 79.
Sand other than metal-bearing	4,062	3,687	12	Taiwan 1,226; Republic of Korea 1,189; Singapore 703.
Sulfur:				
Elemental:				
Crude including native and by-product	165,981	77,815	420	Republic of Korea 67,749; Taiwan 8,790.
Colloidal, precipitated, sublimed	382	1,201	33	Canada 453; Taiwan 337; Republic of Korea 309.
Sulfuric acid	322,568	500,421	18,503	Republic of Korea 147,701; Taiwan 132,561; Philippines 117,089.
Talc, steatite, soapstone, pyrophyllite	4,792	3,518	50	Republic of Korea 1,742; Taiwan 870; Philippines 297.
Other:				
Crude	24,584	29,590	507	Republic of Korea 21,163; Taiwan 3,607; Indonesia 840.
Slag and dross, not metal-bearing	325,276	392,975	36,006	Singapore 175,300; Republic of Korea 52,863.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	7	12	1	Republic of Korea 6; Western Samoa 3; Sri Lanka 2.
Carbon black	9,940	8,405	567	Republic of Korea 2,119; Taiwan 1,850; Indonesia 1,310.
Coal, all grades including briquets	4,242	1,167	--	Republic of Korea 560; Cuba 200; Taiwan 171.
Carbon black	9,940	8,405	567	Republic of Korea 2,119; Taiwan 1,850; Indonesia 1,310.
Coal, all grades including briquets	4,242	1,167	--	Republic of Korea 560; Cuba 200; Taiwan 171.
Coke and semicoke thousand tons	2,264	2,348	232	Romania 753; Philippines 261; Taiwan 169.
Peat including briquets and litter	253	272	--	All to China.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	410	184	174	U.S.S.R. 5; Hong Kong 4.
Gasoline do.	319	122	(2)	Taiwan 78; Indonesia 25; Philippines 10.
Mineral jelly and wax do.	493	516	75	Republic of South Africa 93; Republic of Korea 85; India 77.
Kerosene and jet fuel do.	414	1,356	—	Iran 1,059; Republic of Korea 292.
Distillate fuel oil do.	419	2,270	3	Iran 1,652; Republic of Korea 613.
Lubricants do.	1,195	1,531	50	Republic of Korea 527; Taiwan 208; Singapore 200.
Nonlubricating oils do.	255	246	2	Republic of Korea 90; Taiwan 73.
Residual fuel oil do.	1,444	1,797	—	Republic of Korea 1,796.
Bitumen and other residues do.	40	17	(2)	Singapore 5; Thailand 4; Indonesia 2.
Bituminous mixtures do.	7	8	(2)	Indonesia 4.
Petroleum coke do.	390	582	114	Romania 148; U.S.S.R. 142; Netherlands 103.

[1]Excludes exports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey Wilkes.
[2]Less than 1/2 unit.

Table 3.—Japan: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkaline-earth metals	71	124	33	China 82; West Germany 6.
Unspecified	859	1,062	347	China 393; France 262.
Aluminum:				
Ore and concentrate thousand tons	3,519	2,307	(2)	Australia 1,354; Indonesia 597; Malaysia 238.
Oxides and hydroxides	44,005	66,053	21,085	Australia 11,260; West Germany 2,938.
Metal including alloys:				
Scrap	361,053	358,813	241,747	Australia 26,776; Hong Kong 20,155; Canada 10,535.
Unwrought	1,576	1,366	157	Australia 306; Venezuela 171; New Zealand 169.
Semimanufactures	34,825	35,595	5,454	Romania 6,140; Argentina 3,361; France 3,068.
Antimony:				
Ore and concentrate	5,091	6,400	—	Bolivia 4,829; China 979; Guatemala 400.
Oxides	2,672	3,609	91	China 1,950; United Kingdom 1,117.
Metal including alloys, all forms	4,269	3,985	—	China 3,982.
Arsenic: Oxides and acids	144	161	—	France 140; Republic of Korea 17.
Beryllium:				
Oxides and hydroxides	100	100	80	China 20.
Metal including alloys, all forms kilograms	744	1,253	1,241	China 10.
Chromium:				
Ore and concentrate	987,240	670,625	—	Republic of South Africa 379,867; Madagasgar 102,567; India 49,710.
Oxides and hydroxides	2,278	2,300	1,132	West Germany 918; U.S.S.R. 100.
Cobalt:				
Oxides and hydroxides	259	460	48	Belgium-Luxembourg 346.
Metal including alloys, all forms	2,312	3,453	201	Zaire 2,016; Belgium-Luxembourg 396; Zambia 359.
Columbium and tantalum:				
Ore and concentrate	2,195	1,717	—	Canada 1,502; Brazil 169.
Metal including alloys, all forms, tantalum	79	46	36	West Germany 8.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
METALS —Continued				
Copper:				
Ore and concentrate thousand tons	3,010	3,037	457	Canada 910; Chile 322; Philippines 307.
Matte and speiss including cement copper	132	33		All from Taiwan.
Sulfate	400	650	(2)	China 278; U.S.S.R. 180; Thailand 68.
Metal including alloys:				
Scrap	81,663	79,467	38,202	Hong Kong 11,689; Saudi Arabia 7,423; Singapore 6,979.
Unwrought	r393,151	303,034	305	Zambia 138,607; Chile 48,332; Peru 42,449.
Semimanufactures	r14,189	21,134	1,483	Taiwan 11,583; Republic of Korea 4,432; Italy 1,395.
Germanium: Metal including alloys, all forms kilograms	3,975	2,878	210	China 2,002; France 400.
Gold:				
Ore and concentrate value, thousands	$36			
Waste and sweepings kilograms	1,011	1,666		Singapore 1,353; Hong Kong 313.
Metal including alloys, unwrought and partly wrought thousand troy ounces	6,328	19,542	7,552	United Kingdom 4,243; Switzerland 3,753.
Indium: Metal including alloys, all forms kilograms	8,249	21,524	8,204	China 7,360; Belgium-Luxembourg 2,696.
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite thousand tons	124,513	115,234		Australia 46,894; Brazil 26,833; India 20,750.
Metal:				
Scrap do.	3,254	3,224	1,635	U.S.S.R. 826; Australia 216.
Pig iron, cast iron, related materials do.	748	968	1	Republic of South Africa 541; Brazil 174; U.S.S.R. 105.
Ferroalloys:				
Ferrochromium	317,595	372,513		Republic of South Africa 235,213; Philippines 43,181; Zimbabwe 34,679.
Ferromanganese	5,878	7,125		Brazil 3,488; India 986; Norway 703.
Ferromolybdenum	988	1,065		Austria 360; Chile 323; China 142.
Ferronickel	20,247	38,700	157	New Caledonia 13,690; Indonesia 13,073; Dominica 5,976.
Ferrosilicochromium	10,026	10,356		Zimbabwe 5,200; Republic of South Africa 5,056.
Ferrosilicomanganese	121,600	176,821		Republic of South Africa 72,819; Brazil 51,167; U.S.S.R. 24,489.
Ferrosilicon	306,830	350,069		Norway 83,087; Brazil 79,386; Republic of South Africa 28,039.
Silicon metal	102,797	103,860	1,941	China 33,277; Norway 15,890; Brazil 13,480.
Unspecified	10,839	11,936	94	Brazil 4,741; China 1,873; France 1,688.
Steel, primary forms	r1,644,374	1,743,567	18,077	Republic of Korea 702,430; Brazil 447,198; Republic of South Africa 81,358.
Semimanufactures:				
Universals, plates, sheets[4] do.	1,075,305	1,230,439	7,844	Republic of Korea 506,654; Brazil 179,345; Romania 153,484.
Unspecified[5]	r2,925	316,033	1,903	Republic of Korea 220,664; Singapore 17,802.
Lead:				
Ore and concentrate	261,795	273,829	18,224	Canada 67,319; Australia 60,665; Peru 45,007.
Oxides	8,518	12,070	9	Mexico 10,714; China 885; France 298.
Metal including alloys:				
Scrap	185	83	17	Papua New Guinea 49; Singapore 17.
Unwrought	87,840	70,346	760	Australia 25,331; Taiwan 9,651; Mexico 8,410.
Semimanufactures	41	43	42	France[2].
Lithium:				
Oxides and hydroxides	797	885	725	China 81; U.S.S.R. 60.
Metal including alloys, all forms	42	50	35	United Kingdom 8; West Germany 7.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS —Continued				
Magnesium: Metal including alloys:				
Scrap	293	472	(2)	Taiwan 191; Sweden 125; West Germany 51.
Unwrought	15,621	12,643	8,620	Norway 2,231; Canada 1,184.
Semimanufactures	318	398	336	Canada 43; Republic of Korea 13.
Manganese:				
Ore and concentrate, metallurgical-grade thousand tons	2,183	1,807	—	Republic of South Africa 1,018; Australia 399; India 226.
Oxides	1,782	1,421	35	Belgium-Luxembourg 1,340; China 34.
Mercury 76-pound flasks	513	860	(2)	China 720; Algeria 100.
Molybdenum:				
Ore and concentrate	21,138	18,024	4,522	Chile 7,272; Canada 3,485; Netherlands 1,934.
Oxides and hydroxides	384	414	269	Taiwan 55; China 41.
Metal including alloys, all forms	427	290	118	West Germany 106; Austria 29; China 28.
Nickel:				
Ore and concentrate thousand tons	2,976	2,886	NA	Indonesia 1,367; New Caledonia 982; Philippines 511.
Matte and speiss	52,462	58,187	—	Indonesia 35,858; Australia 21,753.
Metal including alloys:				
Scrap	2,622	2,219	1,366	Taiwan 533; United Kingdom 56.
Unwrought	25,092	24,475	545	Canada 4,072; U.S.S.R. 3,744; Zimbabwe 3,262.
Semimanufactures	5,577	5,256	617	United Kingdom 1,991; Philippines 1,260.
Platinum-group metals:				
Ore and concentrate	$1	—	—	
Waste and sweepings kilograms	2,664	3,179	1,478	Taiwan 1,383; Australia 240.
Metals including alloys, unwrought and partly wrought:				
Palladium thousand troy ounces	1,107	1,369	96	U.S.S.R. 851; Republic of South Africa 244; Taiwan 106.
Platinum do.	1,304	996	64	Republic of South Africa 571; U.S.S.R. 148.
Rhodium do.	61	93	8	U.S.S.R. 48; Republic of South Africa 26.
Iridium, osmium, ruthenium do.	86	73	(2)	Republic of South Africa 55; United Kingdom 11.
Rare-earth metals including alloys, all forms	60	132	10	China 83; Brazil 33.
Selenium, elemental	12	8	(2)	Philippines 7.
Silicon, high-purity	144	66	23	France 16; Italy 11; Denmark 10.
Silver:				
Ore and concentrate	68	1,907	11	Australia 1,814; Spain 82.
Waste and sweepings kilograms	701	819	—	All from Malaysia.
Metal including alloys, unwrought and partly wrought thousand troy ounces	18,351	15,488	1,916	Mexico 8,283; Peru 3,608.
Tellurium, elemental	4	1	(2)	Mainly from Belgium-Luxembourg.
Tin:				
Ore and concentrate	48	2	—	All from China.
Oxides	8	9	—	United Kingdom 8.
Metal including alloys:				
Scrap	15	4	—	Mainly from Philippines.
Unwrought	30,282	32,311	NA	Malaysia 14,794; Thailand 8,871; Indonesia 4,955.
Semimanufactures	53	278	5	Thailand 237; Malaysia 16; Taiwan 12.
Titanium:				
Ore and concentrate	604,044	670,436	—	Malaysia 261,524; Australia 288,309; Canada 116,547.
Oxides	6,285	4,864	123	Republic of Korea 1,412; Belgium-Luxembourg 1,371; China 1,354.
Tungsten:				
Ore and concentrate	2,869	1,769	18	Portugal 680; Republic of Korea 334; Bolivia 231.
Metal including alloys, all forms	350	255	27	Republic of Korea 116; West Germany 84.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS —Continued				
Uranium and/or thorium:				
Oxides and other compounds kilograms	807	1,068	140	India 600; West Germany 328.
Metal including alloys, all forms, uranium do.	38	(e)	(e)	
Vanadium:				
Ore and concentrate	--	68	--	All from Republic of South Africa.
Oxides and hydroxides	3,786	3,101	107	Republic of South Africa 2,551; China 299.
Zinc:				
Ore and concentrate	856,648	916,166	3,775	Australia 496,981; Peru 225,549; Canada 129,865.
Oxides	6,746	7,368	50	Republic of Korea 3,389; Taiwan 2,279; China 993.
Metal including alloys:				
Scrap	345	57	7	Singapore 34; Malaysia 16.
Unwrought	70,549	101,444	17	North Korea 39,054; Peru 21,716; Mexico 10,781.
Semimanufactures	385	857	89	Norway 395; West Germany 155.
Zirconium:				
Ore and concentrate	238,321	171,709	24	Australia 151,762; Republic of South Africa 18,513.
Metal including alloys, all forms	173	131	44	France 84.
Other:				
Ores and concentrates	119	10,769	10,709	Canada 45.
Oxides and hydroxides	592	576	11	Norway 346; Canada 179.
Ashes and residues	89,898	76,268	16,072	Australia 24,967; Taiwan 11,881; Philippines 7,218.
Base metals including alloys, all forms	6,470	5,284	1,342	Republic of South Africa 2,179; China 1,051.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc	9,889	6,820	1,792	India 4,032; Australia 542.
Artificial:				
Corundum	22,529	28,050	154	China 17,806; Brazil 4,864.
Silicon carbide	23,994	28,475	62	China 14,672; Brazil 5,964; Norway 3,092.
Dust and powder of precious and semiprecious stones excluding diamond kilograms	421,400	593,386	77,626	India 378,000; West Germany 137,760.
Grinding and polishing wheels and stones	352	388	36	Austria 134; Italy 81; Republic of Korea 52.
Asbestos, crude	261,648	255,732	9,483	Canada 100,642; Republic of South Africa 57,119; Zimbabwe 36,920.
Barite and witherite	50,356	30,962	5	China 30,927.
Boron materials:				
Crude natural borates	59,075	57,250	--	Turkey 56,000; U.S.S.R. 1,250.
Elemental[7]	41	44	(e)	China 33; Sweden 10.
Oxides and acids	26,393	25,236	18,318	Italy 4,641; U.S.S.R. 618.
Bromine and iodine	3,156	3,078	264	Israel 2,814.
Cement	476,928	1,196,485	38	Republic of Korea 757,038; Taiwan 435,759.
Chalk	3	205	1	Denmark 204.
Clays, crude:				
Kaolin	706,745	678,359	464,755	Brazil 92,535; Republic of Korea 52,053; Malaysia 22,092.
Unspecified	281,951	284,022	138,961	China 109,424; Republic of Korea 18,930.
Cryolite and chiolite	437	357	--	Denmark 255; Greenland 102.
Diamond:				
Gem, not set or strung thousand carats	1,224	1,774	134	India 733; Israel 381; Belgium-Luxembourg 314.
Industrial stones do.	722	738	160	Republic of South Africa 272; Zaire 152; Ghana 42.
Dust and powder do.	33,056	37,419	10,968	Ireland 24,425; Zaire 948; West Germany 484.
Diatomite and other infusorial earth	3,164	3,901	3,880	West Germany 10.
Feldspar	7,802	6,766	--	China 3,626; Canada 1,438; North Korea 880.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986: United States	Sources, 1986: Other (principal)
INDUSTRIAL MINERALS —Continued				
Fertilizer materials:				
Crude, n.e.s.	1,184	24,585	—	Italy 22,000; Philippines 1,134; Argentina 790.
Manufactured:				
Ammonia kilograms	435	926	288	West Germany 638.
Nitrogenous	73,151	203,285	10,695	Indonesia 76,709; Qatar 29,407; Malaysia 27,480.
Phosphatic	54,558	107,919	42,673	Republic of Korea 34,766; China 29,213.
Potassic	1,375,430	1,199,454	163,036	Canada 568,376; U.S.S.R. 168,567; West Germany 107,772.
Unspecified and mixed	324,610	374,144	273,020	Republic of Korea 66,903; Philippines 16,560.
Fluorspar	570,656	527,236	—	China 350,833; Thailand 75,529; Republic of South Africa 70,304.
Graphite, natural	78,857	58,645	266	China 30,944; Republic of Korea 19,512.
Gypsum and plaster	305,694	776,349	453	Thailand 419,553; Mexico 273,904.
Kyanite and related materials	28,413	28,653	7,206	Republic of South Africa 21,376.
Magnesium compounds:				
Magnesite, crude	38,538	33,613	1	China 32,369; North Korea 743.
Oxides and hydroxides	304,073	238,320	206	China 200,257; North Korea 32,264.
Meerschaum, amber, jet	31	82	—	China 81.
Mica:				
Crude including splittings and waste	10,865	15,143	276	India 7,086; Canada 2,600; China 2,075.
Worked including agglomerated splittings	105	166	2	Belgium-Luxembourg 84; India 72.
Nitrates, crude	3,000	—	—	—
Phosphates, crude thousand tons	2,414	2,076	1,099	Morocco 510; Jordan 306.
Phosphorus, elemental	24,552	25,119	8,432	Canada 9,006; China 2,046; Netherlands 1,972.
Pigments, mineral:				
Natural, crude	386	847	5	China 694; Austria 119.
Iron oxides and hydroxides, processed	12,724	8,552	1,948	West Germany 5,169; Italy 408.
Precious and semiprecious stones other than diamond:				
Natural:				
Gem material kilograms	331,822	402,959	21,070	Brazil 159,131; Republic of South Africa 49,281; Turkey 40,850.
Industrial stones do.	5	3	—	All from West Germany.
Synthetic do.	79,735	136,049	106,181	West Germany 25,225.
Pyrite, unroasted	2,281	28,246	2	Australia 16,617; China 7,531; Philippines 4,096.
Salt and brine thousand tons	6,832	6,614	(2)	Australia 3,188; Mexico 2,729; China 697.
Sodium compounds, n.e.s.:				
Carbonate, natural and manufactured	1	4,283	—	Kenya 3,245; Republic of Korea 1,000.
Sulfate, manufactured	85,274	95,856	19,149	China 56,711; Mexico 10,599; Taiwan 8,847.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	704,910	870,355	22,797	Republic of Korea 285,820; India 196,882; China 136,991.
Worked	107,649	148,296	59	Republic of Korea 80,496; Italy 24,952.
Dolomite, chiefly refractory-grade	488,511	520,560	3,303	Philippines 273,009; Republic of Korea 118,701.
Gravel and crushed rock	217,421	189,709	408	Taiwan 168,285; Philippines 10,677.
Limestone other than dimension	648	15,721	(2)	Philippines 15,017; France 660.
Quartz and quartzite	142,496	120,638	1,691	India 73,059; Thailand 18,800; China 13,490.
Sand other than metal-bearing thousand tons	1,229	1,227	1	Australia 773; Taiwan 316; Malaysia 98.
Sulfur:				
Elemental:				
Crude including native and by-product	87	2,023	—	All from China.
Colloidal, precipitated, sublimed	4	58	(2)	China 50; West Germany 5.
Sulfuric acid	5	13	6	Taiwan 6.
Talc, steatite, soapstone, pyrophyllite	573,901	614,422	18,652	China 456,318; Australia 110,859.
Other:				
Crude	272,664	245,979	5,097	Republic of Korea 134,571; China 32,329; Spain 24,284.
Slag and dross, not metal-bearing	434,449	435,323	22,730	Republic of Korea 127,372; Taiwan 85,291; Republic of South Africa 74,857.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
MINERALS FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	3,186	3,322	2,443	Trinidad and Tobago 879.
Carbon black	9,173	10,846	6,354	Republic of Korea 1,234; Canada 947.
Coal:				
Anthracite thousand tons	1,950	1,971	(2)	Republic of South Africa 875; North Korea 406; Australia 299.
Bituminous do.	91,040	89,376	12,178	Australia 41,975; Canada 17,541; Republic of South Africa 7,960.
Lignite including briquets	31,585	25,415	653	U.S.S.R. 19,330; Australia 4,392; China 1,040.
Coke and semicoke	34,805	44,977	944	Australia 33,567; Taiwan 4,497; China 3,607.
Gas, natural: Liquefied thousand tons	27,790	28,394	964	Indonesia 14,916; Brunei 5,262; Malaysia 5,028.
Peat including briquets and litter	20,789	31,577	182	Canada 28,429; U.S.S.R. 1,759.
Petroleum:				
Crude thousand 42-gallon barrels	1,218,423	1,157,267	(3)	United Arab Emirates 262,093; Saudi Arabia 202,282; Indonesia 132,854.
Refinery products:				
Liquefied petroleum gas do.	133,645	137,719	(3)	Saudi Arabia 65,785; United Arab Emirates 33,098; Australia 13,886.
Gasoline do.	109,990	132,945	5,092	Saudi Arabia 28,895; Kuwait 17,266; Singapore 16,954.
Mineral jelly and wax do.	76	174	38	Singapore 97; Republic of South Africa 22.
Kerosene and jet fuel do.	12,817	32,859	1,307	Singapore 10,720; Saudi Arabia 5,054; United Arab Emirates 4,128.
Distillate fuel oil do.	3,168	9,836	3,114	Algeria 1,686; Saudi Arabia 1,476; China 1,390.
Lubricants do.	226	269	173	West Germany 35; Republic of Korea 23.
Nonlubricating oils do.	154	169	114	Taiwan 31.
Residual fuel oil do.	93,207	103,377	10,687	Indonesia 25,688; Singapore 18,039; Saudi Arabia 13,491.
Bitumen and other residues do.	140	250	172	NA.
Bituminous mixtures do.	11	13	5	Republic of Korea 6.
Petroleum coke do.	19,960	21,415	19,764	China 773.

[r] Revised. NA Not available.

[1] Excludes imports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey D. Wilkes.

[2] Less than 1/2 unit.

[3] Excludes unreported quantity valued at $1,257,000.

[4] Excludes unreported quantities valued at $17,497,000 in 1985 and $2,797,000 in 1986.

[5] Excludes unreported quantities valued at $57,411,000 in 1985 and $58,545,000 in 1986.

[6] Unreported quantity valued at $33,880.

[7] May include some arsenic.

COMMODITY REVIEW

METALS

Aluminum.—Production of primary aluminum dropped sharply to a record low since 1952 when two of the remaining three primary aluminum smelters closed their plants permanently in March. The Miike plant operated by Mitsui Aluminium Co. Ltd. and the Sakaide plant operated by Ryoka Light Metal Industries Ltd. stopped production in April. Japan, once the world's third largest primary aluminum producer with a 1.6-million-ton-per-year capacity in 1977, was reduced to an insignificant producer with only one plant having a 64,000-ton-per-year capacity and operated by Nippon Light Metal Co. Ltd. at Kanbara in Shizuoka Prefecture. The increased cost of electricity since the second oil crisis in 1979 and more imports of low-priced primary aluminum were the main factors for the decline.

In 1987, primary aluminum production by Mitsui Aluminium and Ryoka Light Metal was 4,982 tons and 3,892 tons, respectively. Production by Nippon Light Metal totaled 31,759 tons, which was 50% of its Kanbara plant capacity. As a result of a drastic reduction in domestic production and stronger domestic demand, imports of primary aluminum surged to a record high while stocks of domestic producers depleted

to 15,245 tons at yearend from 62,986 tons in 1986. Japan's domestic production of primary aluminum provided only 2% of domestic demand in 1987.

To meet domestic demand in 1987, Japan's imports of primary aluminum rose 36.5% to 1,657,566 tons, of which 1,370,949 tons was regular-grade ingot; 57,332 tons, high-grade ingot; and 229,285 tons, low-grade and aluminum alloy ingot. Australia remained Japan's largest supplier, accounting for 25% of imports, followed by Brazil, 15%; the United States, 14%; Venezuela, 12%; New Zealand, 11%; and Indonesia, 10%.

According to Sumitomo Corp., a Tokyo-based trading company, imports of primary aluminum and aluminum alloy from the spot market rose to 770,000 tons from 194,000 tons in 1986, those from long-term contracts rose to 500,000 tons from 420,000 tons in 1986, and those from overseas captive-import development projects declined to 560,000 tons from 586,000 tons in 1986.[6] The substantial increase in imports from the spot market after March 1987 was due to permanent closures of two domestic plants and a reduction in the tariff on primary aluminum from 9% to 5% effective in April.

Under an agreement between the Governments of Japan and the United States in October 1986, Japan was to cut further the tariff on imports of primary aluminum from 5% to 1% on April 1, 1988. However, in September, the Japan Aluminium Federation (JAF) asked the Government to eliminate the tariff on primary aluminum. JAF's action reportedly was part of its policy to secure stable supplies of primary aluminum and remove the obstacle to establishing a London Metal Exchange-designated warehouse of primary aluminum to Tokyo.[7]

Domestic demand for primary aluminum increased 14% to 2.1 million tons owing largely to an 11% increase in consumption by the aluminum rolling sector to 1.6 million tons and a 133% increase in consumption for secondary smelting to 155,866 tons. Consumption by other major sectors included 154,606 tons for aluminum casting and diecasting, 71,955 tons for wire and cable, and 34,832 tons for steel deoxidization. Exports of primary aluminum dropped further to 854 tons, of which 505 tons went to the Republic of Korea and 149 tons went to the United States. The yearend overall stocks of primary aluminum were 210,880 tons, of which 15,245 tons was held by producers, 92,872 tons was held by dealers and 97,763 tons was held by consumers. These levels were about the same at yearend 1986.

Because of the appreciation of the yen and low U.S. dollar-based prices of primary aluminum in the world market, Aluminio Brasilerio Ltda. (ALBRAS) of Brazil and P.T. Indonesia Asahan Aluminum (INALUM) of Indonesia reportedly suffered losses and experienced difficulties in repaying interest and principal on their yen-denominated loans. In June, the Government of Japan, through the Overseas Economic Cooperation Fund, decided to provide financial assistance for these aluminum smelting projects. The financial assistance package to ALBRAS included $42.7 million in additional financing, lowering of interest rates on the existing loans to 5.0%-5.2% from 7.14%-7.6%, and extending repayment terms to 20 years from 15. The assistance package to IN-ALUM included $160 million in additional financing, lowering of interest rates to 5.0%-5.2% from 6.48%-8.45%, and extending repayment terms to 30 years from 20.[8]

Imports of bauxite dropped to 1,872,020 tons from 2,307,459 tons in 1986 owing to reduced domestic demand for metallurgical-grade alumina. Australia remained the dominant supplier, accounting for 60% of imports, followed by Indonesia, 26%; and Malaysia, 14%. The combined production of alumina by the Shimizu plant of Nippon Light Metal, the Yokohama plant of Showa Denko K.K., and the Kikumoto plant of Sumitomo Chemical Co. Ltd. dropped 41% to 357,981 tons. In 1987, exports of alumina also dropped from 384,472 tons in 1986 to 198,844 tons, of which 101,056 tons was aluminum oxide and 97,788 tons was aluminum hydroxide.

Despite a drastic decline in the domestic demand for metallurgical-grade alumina, demand for non-metallurgical-grade alumina reportedly rose considerably. According to JAF, the domestic demand for aluminum hydroxide by nonsmelting end users rose to 358,000 tons in 1985 from 278,200 tons in 1981. The principal consumers of aluminum hydroxide in nonsmelting areas in 1985 were the manufacturers of coagulant, 164,000 tons; fluorides, 39,000 tons; rubber and plastics, 25,000 tons; catalysts, 20,000 tons; and cleaning materials, 18,000 tons. The domestic demand for aluminum oxide by nonsmelting end users also rose to 270,000 tons in 1985 from 209,800 tons in 1981. The major consumers of aluminum oxide in nonsmelting areas in 1985 were the

manufacturers of refractory materials, 176,000 tons and alumina ceramics, 47,000 tons.

To meet the growing demand for alumina in nonsmelting areas, Japan imported 26,984 tons of non-metallurgical-grade alumina in 1987. The principal suppliers were the United States, 12,744 tons; Australia, 11,223 tons; the Federal Republic of Germany, 946 tons; France, 731 tons; Turkey, 550 tons; and China, 429 tons.

Chromium.—Domestic production of chromium ore and concentrate mainly by Nippon Chrome Industries Ltd. at its Wakamatsu Mine in Tottori Prefecture increased slightly from that of 1986. Japan continued to import 99% of its requirements for chromium ore and concentrate in 1987. These imports increased slightly to 674,743 tons despite reduced metallurgical-grade chromite consumption for ferrochromium. The major overseas suppliers were the Republic of South Africa, 454,757 tons, Madagascar, 81,227 tons; India, 39,499 tons; New Caledonia, 28,061 tons; and Albania, 24,957 tons.

Because of reduced domestic ferrochromium production resulting from the high cost of electricity, consumption of metallurgical-grade chromium ore and concentrate dropped to about 540,000 tons from 563,015 tons in 1987. Despite a tight supply of ferrochromium in the second half of 1987, the Uji plant in Kyoto Prefecture, operated by Awamura Metal Industries Co. Ltd., and the Sakata plant in Yamagata Prefecture, operated by Japan Metals & Chemical Co. Ltd. reportedly were shut down in April and October, respectively. As a result, imports of the ferroalloy surged to a record 427,711 tons in 1987. The Republic of South Africa remained the dominant supplier accounting for 59% of total imports. Others were India, 12%; the Philippines, 11%; Zimbabwe, 6%; and Brazil and Greece, 2% each. Import c.i.f. prices of ferrochromium rose to $0.46 per pound in October from $0.40 per pound in March. The higher import price, was caused by an unexpected strong demand by the stainless steel industry and a short-term tight supply of ferrochromium in the world market during the second half of 1987.

Cobalt.—Japan stopped normal-scale refining of cobalt in 1987. Nippon Mining Co. Ltd. and Sumitomo Metal Mining Co. Ltd. shut down their cobalt refining facilities at the Nikko plant in Ibaraki Prefecture and the Niihama plant in Ehime Prefecture, respectively, in 1986 owing to lack of raw materials. However, Sumitomo Metal Mining reportedly recovered 124 tons of cobalt metal from import nickel-matte residues at its Niiham plant in 1987.

Japan remained 100% dependent on imports to meet its domestic requirements for cobalt in 1987. Because of stronger demand for cobalt, imports of cobalt metal, including powder and flakes, reached a record high 4,557 tons, of which 3,818 tons was ingot and 739 tons was powder and flakes. The principal suppliers were Zaire, 3,236 tons; Zambia, 403 tons; Belgium, 401 tons; and Norway, 218 tons.

According to MITI's official statistics, consumption of cobalt rose to 1,907 tons from 1,651 tons in 1986 owing primarily to increased demand by makers of specialty steels and magnetic materials. In 1987, cobalt consumption by specialty steel producers was 493 tons; for magnetic materials, 427 tons; for catalysts, 281 tons; for carbide tool steels, 251 tons; and other, 455 tons.

As part of the ongoing investigation for deep ocean floor manganese nodules, seabed hydrothermal deposits, and cobalt-rich crusts by its research vessel, *No.2 Hakurei Maru*, MMAJ announced the discovery of several promising seabed cobalt-rich crust deposits in the north Pacific Ocean between the Minami-Tori Island of Japan and the Wake Island of the United States in late 1987. According to MMAJ, seabed samples collected by the vessel assayed 25.0% manganese, 0.9% cobalt, 0.5% nickel, and 0.1% copper.[9]

Copper, Lead, and Zinc.—Mine production of copper, lead, and zinc dropped sharply to record-low levels since 1947, 1955, and 1960, respectively. The further decline in production of these ores was caused by the closure of four major mines in 1987 resulting from the higher yen which made domestic ore and concentrate less competitive.

The Hosokura Mine in Miyagi Prefecture, a lead-zinc operation of Hosokura Mining, was closed in February. The Akenobe Mine in Hyogo Prefecture, a copper-tin-zinc operation of Akenobe Mining, and the Syakanai Mine in Akita Prefecture, a copper-lead-zinc operation of Syakanai Mining, were closed in March. The Nakatatsu Mine in Fukui Prefecture, a lead-zinc mine operation of Nippon Zinc Mining, was closed in September.

The following mines remained in operation throughout 1987: the Hanaoka Mine in Akita Prefecture, Japan's largest nonferrous metal mine operated by Hanaoka Min-

ing Co. Ltd.; the Kamioka Mine in Gifu Prefecture, Japan's second largest nonferrous metal mine operated by Kamioka Mining and Smelting Co. Ltd.; the Kamaishi Mine in Iwate Prefecture, a copper-iron ore mine operated by Shin-Kamaishi Mining Co. Ltd.; the Toyoha Mine in Hokkaido Prefecture, a lead-zinc mine operated by Toyoha Mining Co. Ltd.; the Kosaka Mine in Akita Prefecture, a copper-lead-zinc mine operated by Uchinotai Mining Co. Ltd.; and the Yatani Mine in Yamagata Prefecture, a lead-zinc mine operated by Yatani Mining Co. Ltd. These mines, survivors of two major restructuring programs in 1983 and 1986, were considered to have sufficient ore reserves to continue efficient operations.

In April, a new nonferrous metal mine, the Nurukawa Mine, was brought into production by Uchinotai Mining Co., a subsidiary of Dowa Mining Co. Ltd. The mine, in south-central Aomori Prefecture, is about 1 kilometer west of Lake Towada in northern Akita Prefecture. The kuroko (polymetallic black ore) deposit was first discovered by MMAJ in 1974. Dowa Mining began underground drifting and drilling in 1982, started mine development in 1985 and completed development in November 1986. The ore reserves at the mine were estimated at 1 million tons, of which 950,000 tons are black ore averaging 0.9% copper, 5% lead, 10% zinc, plus 10 grams of gold and 150 grams of silver per ton of ore. The remaining 50,000 tons are gold ore averaging 13.3 grams of gold per ton of ore.[18]

According to Uchinotai Mining, the deposit occurs at the top of the Lower Hayssemori formation and consists of 5 ore bodies. The company started mining at the No. 5 ore body in April at the rate of 4,000 tons per month of black ore averaging 0.80% copper, 4.26% lead, 9.14% zinc, and 7.20 grams of gold and 135 grams of silver per ton of ore; and 1,000 tons per month of gold ore averaging 9.00 grams of gold and 40 grams of silver per ton of ore plus 1.17% copper, 2.36% lead, and 2.10% zinc. The ore was transported by battery-operated locomotives through a 1,635-meter adit to the surface. There it went into dump trucks for transport to the company's Kosaka milling and smelting facilities in Akita Prefecture.

Japan's production of copper, lead, and zinc ore provided 2.4%, 10.4%, and 24.9%, respectively, of its smelters' requirements in 1987. To meet its smelters' requirements, Japan imported 2,981,054 tons of copper ore and concentrate, 294,728 tons of lead ore and concentrate, and 974,026 tons of zinc ore and concentrate in 1987. The principal suppliers of copper ore and concentrate were Canada, 976,114 tons; the United States, 389,603 tons; the Philippines, 343,601 tons; Chile, 277,873 tons; Papua New Guinea, 264,239 tons; and Indonesia, 229,256 tons. The principal suppliers of lead ore and concentrate were Canada, 101,327 tons; Australia, 80,474 tons; the Republic of South Africa, 35,265 tons; and Peru, 34,288 tons. The principal suppliers of zinc ore and concentrate were Australia, 439,206 tons; Peru, 209,280 tons; and Canada, 203,035 tons.

Production of refined copper continued its upward trend and reached a new high since 1984 following an unexpected strong demand in the second half of 1987. Capacity utilization of the copper smelting and refining industry averaged 79%. As a result of stronger demand in 1987, imports of refined copper rose 28% to 347,667 tons. The major suppliers were Zambia, 167,592 tons; Chile, 65,419 tons; the Philippines, 43,883 tons; Peru, 18,159 tons; and Australia, 16,795 tons. Japan also imported 27,914 tons of blister copper, of which 26,916 tons came from Peru.

Production of refined lead increased slightly owing to the growing demand by the batteries sector. Production of slab zinc decreased considerably because of reduced domestic zinc ore production. Capacity utilization of the lead and zinc smelting and refining industries averaged 86% and 77%, respectively. To meet domestic demand, Japan imported 21,030 tons of primary lead, principally from Australia, 8,213 tons; Mexico, 4,044 tons; China, 2,623 tons; and Peru, 2,422 tons. Japan also imported 105,035 tons of slab zinc, principally from North Korea, 36,203 tons; the Republic of Korea, 24,495 tons; Australia, 15,618 tons; and China, 13,279 tons.

Domestic refined copper consumption rose 5% to 1,431,336 tons, of which 952,860 tons was consumed by the wire and cable sector, 461,739 tons by the brass mill sector, and 16,733 tons by manufacturers of copper powder, coins, and copper alloys. Exports of refined copper, mainly to Taiwan and the Republic of Korea, dropped 14% below those of 1986 to 52,403 tons because of the tight domestic market situation in the second-half of 1987. As a result of stronger domestic demand, the overall stocks of refined copper held by producers, fabricators, and dealers dropped 12% by yearend to

90,950 tons or equivalent to less than 1 month of refined copper consumption in 1987.

Domestic consumption of primary lead rose slightly to 275,524 tons mainly because of increased consumption by the storage battery sector, which accounted for 62% of demand. Exports of primary lead dropped sharply to 14,167 tons from 24,167 tons in 1986. As a result of stronger demand and reduced domestic production and imports, the stocks of primary lead held by producers, consumers, and dealers dropped 28% by yearend to 25,716 tons or equivalent to about 1 month of primary lead consumption in 1987.

Domestic consumption of slab zinc rose 5% over 1986 to 749,539 tons owing to a 7.6% increase in demand by the galvanizing sector, which accounted for 61% of consumption. Exports of slab zinc rose 122% to 51,854 tons resulting from increased exports to China, Taiwan, and the United States. By yearend, the overall stocks of slab zinc dropped 10% to 89,818 tons or equivalent to about 1.5 months' of slab zinc consumption in 1987.

To secure their smelters' raw material requirements, a group of major copper producers led by Nippon Mining Co. Ltd. and Mitsubishi Metal Corp. signed an agreement in August with Ok Tedi Mining Ltd. of Papua New Guinea to import 60,000 tons per year of copper concentrate for the year starting in October 1987 and increasing to 230,000 tons per year during the following 7 years. Papua New Guinea, already exporting about 265,000 tons per year of copper concentrate from the Bougainville Mine to Japan, will displace the Philippines and Chile as the third largest supplier of copper concentrate to Japan following Canada and the United States in 1988.

Nittetsu Mining Co. Ltd., a major partner of Hibi copper smelter at Tamano, Okayama, reportedly started in September the development of the El Lobre copper deposit in Medellin, Colombia. The $17 million project for producing 96,000 tons per year of concentrate was a joint venture of Nittetsu Mining and C. Itoh & Co. Ltd. of Japan and Minas El Lobre Ltda. of Colombia. The El Lobre copper project was expected to supply Nittetsu Mining 14,000 tons per year of copper concentrate when production starts in mid-1989.

In early 1987, Mitsui Mining and Smelting Co. Ltd. (MMSC), Japan's largest producer of slab zinc, reportedly acquired about 3% equity of Cominco Ltd. of Canada. Following the acquisition, six Japanese zinc smelters led by MMSC and Tono Zinc Co. Ltd., reportedly, negotiated a long-term contract with Cominco to import 70,000 to 100,000 tons per year of zinc concentrate from the Red Dog Mine in Alaska beginning in 1991. The Red Dog Mine, owned by Cominco, was expected to start production at the rate of 500,000 tons of lead-zinc concentrate per year in 1991. The ore reserves at the mine were estimated at 77 million tons averaging 5.6% lead, 17.1% zinc, and 82.3 grams of silver per ton of ore.

Gallium.—Japan remained one of the world's three leading producers and the largest consumer of gallium metal. Production of high-purity gallium metal was estimated at 20 tons, of which 10 tons was recycled scrap. Consumption of gallium metal including metallic compounds was estimated at 36 tons in 1987. To meet domestic demand, Japan imported 11 tons of high-purity primary gallium and 5 tons of intermediate-purity gallium metal.

Table 4.—Japan: Estimated supply of gallium

(Kilograms)

	1985	1986	1987
Domestic production:			
Primary	10,000	10,000	10,000
Secondary	10,000	9,000	10,000
Imports:			
High-purity:			
France	5,264	2,700	5,600
Germany, Federal Republic of	3,200	4,200	4,900
Switzerland	50	100	740
Intermediate-purity:			
Canada	--	300	300
China	4,000	5,100	2,000
Czechoslovakia	2,285	450	1,100
Hungary	1,800	750	1,500
Total	36,599	32,600	36,140

Source: The Rare Metal News (Tokyo). No. 1444, Apr. 1, 1988, p. 3.

Domestic primary producers were Dowa Mining having a 7-ton-per-year capacity and Sumitomo Chemical Co. Ltd. having a 10-ton-per-year capacity. Dowa Mining extracted 4- to 7-nines-purity gallium from zinc residue, using the ion exchange resins process at its Kosaka refinery in Akita Prefecture. Sumitomo Chemical also extracted 4- to 7-nines-purity gallium using the Bayer liquor process at its Niihama plant in Ehime Prefecture. Secondary producers included Dowa Mining, Sumitomo Chemical, Rasa Industries Co. Ltd., and Nichia Chemical Co. Ltd. Most secondary producers extracted gallium metal from

scrap of gallium arsenide, gallium phosphate, and compound semiconductors using chloride recycling technology. According to an industry source, recycled scrap in 1986 accounted for 30% of the domestic gallium consumption which was estimated at 32 tons.[11]

In January, Ote Metal Co. Ltd. reportedly started recycling gallium arsenide using a low-cost chloride process at the Onahama plant owned by its parent company, Mitsubishi Metal, with a monthly capacity of 500 kilograms of high-purity gallium. In July, Sumitomo Metal Mining also introduced a low-cost chloride recycling technique to extract high-purity gallium at its Isoura plant near the city of Niihama in Ehime Prefecture with a monthly capacity of 300 kilograms, which could be doubled if sufficient scrap supplies were secured.

In January, the National Research Institute for Metals of Japan and Beijing University of Iron and Steel Technology of China signed an agreement for a 4-year joint research program to develop technology for extracting and separating gallium, titanium, and vanadium from complex iron ore mined from the Panzhihua deposit in Sichuan Province of China. The joint research program was expected to end in March 1991. Japan has imported between 2,000 and 5,000 kilograms per year of intermediate-grade gallium with a purity of 3 to 4 nines from the Zhangdian alumina plant in Shandong Province of China. According to a Japanese source, gallium production by the plant was estimated at 7 tons per year. Additionally, the Zhengzhou alumina plant in Henan Province of China planned to produce 2 to 3 tons of crude gallium beginning in 1986.[12] Musto Exploration Ltd. of Canada, reportedly, started to export to Japan in 1986 about 300 kilograms per year of gallium with a purity of 3 to 4 nines. The principal overseas suppliers in 1985-87 of high-grade gallium with a purity between 6 and 7 nines were International Gallium GmbH of the Federal Republic of Germany, Rhône-Poulenc S.A. of France, and Alcan Electronic Materials of Switzerland.

Gold and Silver.—Despite increased output from the Hishikari gold mine, mine production of gold and silver declined substantially resulting from the closure of two major copper-lead-zinc mines in 1987. The two mines recovered a considerable amount of gold and silver as byproducts. In 1987, Japan's mine production of gold was equivalent to 15% of its requirement for domestic gold metal production and 2.4% of domestic gold demand, and that of silver was equivalent to 15% of its requirement for domestic silver metal production and 10% of domestic silver demand.

Domestic metal production of gold and silver both broke the previous record-high level as a result of processing more imported raw materials primarily copper concentrates. Gold metal production by source of raw material was 25% from domestic ore, 62% from imported ore, and 13% from scrap and other. Silver metal production by source of raw material was 17% from domestic ore, 52% from imported ore, and 31% from scrap and sources. Domestic metal production of gold and silver was 16% and 64%, respectively, of the domestic demand in 1987.

To meet demand, Japan imported 7.7 million troy ounces of gold and 20.2 million troy ounces of silver in 1987. The major suppliers of gold were Switzerland, 3,272,111 ounces; Australia, 1,180,413 ounces; the U.S.S.R., 906,612 ounces; Canada, 671,628 ounces; the United Kingdom, 621,682 ounces; and the Republic of South Africa, 498,616 ounces. The principal suppliers of silver were Mexico, 11.5 million ounces; Peru, 4.3 million ounces; and the Republic of Korea, 2.7 million ounces.

According to industry sources, domestic consumption of gold declined to 11.3 million ounces from 11.6 million ounces in 1986 because of reduced private hoarding in 1987. Of the gold consumed, 38% was for private hoarding, 24% for jewelry; 15% for communication and electrical equipment; 3% for dental and medical uses; and 20% for arts and crafts, pottery, watches, and other. Consumption of silver rose to 92.2 million ounces from 89.5 million ounces in 1986 resulting from a 9% increase in demand by the photographic materials sector. Of the silver consumed, 56% was for silver-nitrate-sensitive film; 9% for other silver nitrate; 8% for electric contact points; 6% for fabricated silver products; 5% for plating; and 16% for silverware, jewelry, dental and medical uses, and other.

The Hishikari Mine, owned and operated by Sumitomo Metal Mining in Kagoshima Prefecture of southern Kyushu, reportedly made further progress in 1987. The average daily output of ore was raised from 220 tons to 250 tons with ore grade averaging 2.47 ounces of gold and 1.42 ounces of silver per ton of ore. Gold and silver production in 1987 was estimated at 214,500 ounces and

123,300 ounces, respectively. According to Sumitomo Metal Mining, the ore was first crushed and delivered to its Toyo copper smelter near the city of Niihama in Ehime Prefecture. For the 29 months ending in December 1987, ore output totaled 190,000 tons averaging 2.73 ounces of gold and 1.93 ounces of silver per ton of ore. According to a survey conducted in 1986 covering 147 primary gold mines in the world, the Hishikari Mine was ranked the lowest-cost producer. The estimated average mining cost for the Hishikari Mine was $30 per ounce of gold.[12]

Indium.—Japan was one of the top two producers and the largest consumer of indium metal in the world. Because of increased use of indium by the electronic industry, both domestic production and imports surged to all time highs in 1986 and again in 1987. Japan's average import c.i.f. price in 1987 was two times that of 1986. According to Japanese industry sources, strong domestic demand, speculative purchases and tight supply all contributed to the unprecedented rise in the world market price of indium in 1987.

Table 5.—Japan: Estimated supply and demand for indium

(Kilograms)

	1985	1986	1987
Domestic production	16,000	18,000	27,200
Imports	8,200	21,500	31,000
Total supply	24,700	39,500	58,200
Demand:			
Semiconductors	3,700	6000	7,200
Transparent electrode	6,300	10,000	13,000
Fluorescent materials		6,000	7,800
Fusible alloys solder	2,500	4,000	5,200
Dental amalgams	2,900	3,000	3,000
Electrical contacts	1,200	2,000	2,000
Others	5,400	9,200	10,200
Total demand	22,000	40,200	48,400

Source: The Rare Metal News (Tokyo), No. 1444, Apr. 1, 1988, p. 2.

Domestic indium metal with up to 4-nines purity was produced principally by Nippon Mining, which extracted indium at its Saganoseki plant in Oita Prefecture of northeastern Kyushu from zinc slag generated at its affiliated zinc smelters in Japan. The lead-zinc ore containing gold, indium, and silver came mostly from the Toyoha Mine in Hokkaido. To stabilize the market price and meet growing domestic demand, Nippon Mining expanded its indium production capacity from 18 to 24 tons per year in July. Down Mining also extracted between 2 and 3 tons per year of indium with 4-nines purity at its Kosaka plant in Akita Prefecture using leached residue from its affiliated Iijima zinc smelter of Akita Smelting Co. Ltd. in Akita Prefecture. The black ore, containing copper, lead, and zinc and by-product gallium and indium, was mostly from the Kosaka Mine in Akita Prefecture. In addition, MMSC and Sumitomo Metal Mining, reportedly also produced 20 to 30 kilograms of high-purity indium in 1987.

Imports of indium rose to 31,034 kilograms from 21,514 kilograms in 1986. Japan's import c.i.f. price of indium ingot averaged $194 per kilogram compared with $97 per kilogram in 1986. According to Japanese trade data, two-thirds of the indium was imported in the first half of 1987, when import c.i.f. prices jumped from $98.52 per kilogram in early January to $246.88 per kilogram in late June. The import price peaked at $334.89 per kilogram in late July, and that high level extended until yearend. In 1987, the major supplying countries were the United States, 12,240 kilograms; China, 8,520 kilograms; Canada, 2,499 kilograms; Belgium, 2,498 kilogram; and the United Kingdom, 2,292 kilograms.

Iron and Steel.—Domestic production of iron ore and roasted pyrite remained insignificant. Japan continued to import essentially all of its iron ore requirements to meet the demand of its iron and steel industry. Imports of both iron ore and ferruginous manganese ore declined resulting from further reductions in iron ore consumption by the blast furnace sector in 1987.

Imports of iron ore dropped to 112.0 million tons from 115.2 million tons in 1986. The major iron ore suppliers were Australia, 43.4 million tons; Brazil, 26.8 million tons; India, 20.3 million tons; the Republic of South Africa, 5.6 million tons; Chile, 4.5 million tons; and the Philippines, 4.2 million tons. Imports of ferruginous manganese ore dropped from 519,355 tons in 1986 to 344,254 tons, of which 219,790 tons was from the Republic of South Africa and 124,464 tons was from India. The import c.i.f. price of iron ore averaged $23.37 per ton compared with $23.95 per ton in 1986. In 1987, the import c.i.f. price of iron ore from Australia averaged $21.86 per ton, down 84 cents from that of 1986; from Brazil $24.40, down 86 cents; and from India $21.05, down 56 cents.

Consumption of iron ore decreased to 119.8 million tons from 122.4 million tons in 1986 because of lower pig iron production.

Production of pig iron, mostly by blast furnace, declined to 73.4 million tons from 74.7 million tons in 1986 owing to increased consumption of imported pig iron and iron and steel scrap for crude steel production. The output of pig iron was equivalent to 69% of the industry's installed capacity in 1987.

Japan remained the second largest crude steel producer in the world accounting for 13.4% of the world's production in 1987. Despite the lower level of steel exports and continued increase in imports, production of crude steel went up slightly to 98.5 million tons. Increased Government spending on public works reportedly was the major factor that prevented the ailing iron and steel industry from further decline. The output of crude steel in 1987 was equivalent to 65% of the industry's installed capacity of 152.5 million tons per year.

Despite a huge loss in the previous fiscal year because of lower prices and sales, the iron and steel industry overcame difficulties brought about by the yen in 1987. Higher prices of iron and steel products and strong domestic demand in the second half of 1987 helped the Japanese steelmakers maintain their 65% capacity utilization and improve their earnings substantially. Because of the sharp turnaround in the domestic and overseas steel markets in the second half, major Japanese steelmakers reportedly revised their short-term outlook upward and postponed parts of their restructuring program announced in early 1987.

Table 6.—Japan: Crude steel production and rank of the top seven companies

	Output (million metric tons)		Rank among market economy countries	
	1986	1987	1986	1987
Nippon Steel Corp.	26.26	26.03	1	1
Nippon Kokan K.K.	11.21	11.28	5	7
Kawasaki Steel Corp.	10.10	10.13	8	12
Sumitomo Metal Industries Ltd.	10.11	10.12	7	13
Kobe Steel Ltd.	5.94	5.88	19	17
Nisshin Steel Co. Ltd.	3.21	3.36	36	35
Tokyo Steel Manufacturing Co. Ltd.	3.03	3.16	37	37
Total	69.86	69.96	XX	XX

XX Not applicable.

Source: Metal Bulletin (London) No. 7260, Feb. 15, 1988, p. 22.

According to the Japan Iron and Steel Federation (JISF), apparent domestic consumption of steel in terms of crude steel equivalence rose 8.3% to 75.8 million tons in 1987. However, because of the higher level of the yen in 1987, exports of steel in crude steel equivalence declined by 11.9% to 28 million tons while imports continued to increase by 50.6% to 5.3 million. As a result of acute shortages of steel products consumed by the growing construction industry, domestic prices of hot-rolled sheet and small bars rose by 28% and 91% to $569 and $436 per ton, respectively, during the second half of 1987.[14]

According to MITI, exports of iron and steel products dropped 15.3% to 25.7 million tons. Exports, as a percentage of crude steel production, declined to 28.5% from 32.4% in 1986 and 33.2% in 1985. A stronger yen making Japanese steel products more expensive was the single most important reason for a further decline in steel exports. However, because of higher export prices, export earnings decreased only 0.8% below 1986 to $13 billion. In 1987, iron and steel products were exported principally to China, 5.8 million tons; the United States, 4.3 million tons; Taiwan, 2.4 million tons; the Republic of Korea, 2.3 million tons; the U.S.S.R., 2 million tons; and Thailand, 1 million tons. Of the exports of iron and steel products to the United States, 3.6 million tons was ordinary carbon steel, 272,697 tons specialty steels, 89,351 tons wire and wire products, 86,861 tons semifinished steels, and 282,986 tons other products.

Imports of iron and steel rose sharply from 5.3 million tons in 1986 to 7.5 million tons, which were valued at $2.5 billion. Of the imports, 2.1 million tons was hot-rolled strip, 1.4 million tons was pig iron, 1.1 million tons was plates, and 1.0 million tons was ferroalloys. The major suppliers were

the Republic of Korea, 2.1 million tons; Brazil, 800,000 tons; China, 500,000 tons; the U.S.S.R. and Taiwan, 400,000 tons each. Imports from the United States totaled 51,407 tons valued at $67.4 million in 1987. According to JISF, steel imports in crude steel equivalence accounted for 7% of apparent domestic steel consumption compared with 5% in 1986 and 4% in 1985.

In June, a special report on future prospects for the iron and steel industry was completed by an MITI's advisory committee. The committee reporting to MITI's Basic Industries Bureau said that more extensive restructuring and research and development to improve production technology are vital to the future of the industry. The committee also recommended Government subsidies to help industry to restructure and modernize its production technology.

The report indicated that steel production for the domestic market was expected to fall because of declining exports and rising imports caused by the stronger yen and increasing substitution of new materials for steel caused by technological advance.

Manganese.—All of Japan's requirements for manganese were met by imports in 1987. The only domestic producer, Chuugai Mining Co. Ltd., permanently shut down its lead-manganese-zinc operations in May 1986 at Jokoku in Hokkaido.

In 1987, Japan imported 1,216,509 tons of manganese ore and concentrate and 19,899 tons of high-grade manganese dioxide ore for its iron and steel industry and manganese metal production. The Republic of South Africa and Australia remained the dominant suppliers, accounting for 46% and 41%, respectively, of manganese ore and concentrate imports. The suppliers of manganese dioxide ore were Australia, 6,377 tons; Mexico, 5,555 tons; Congo, 4,500 tons; and China, 3,467 tons.

The further decline in imports of manganese ore and concentrate during 1986-87 reportedly was attributable to cutbacks in crude steel production, reduced consumption of low-grade manganese ore, and increased substitution of high-grade manganese ore for ferromanganese in steelmaking through technological improvements. Consumption of manganese ore and concentrate totaled 974,956 tons, of which 935,410 tons was consumed by the iron and steel industry. By yearend, stocks of manganese ore held by the iron and steel industry rose slightly from 466,262 tons at yearend 1986 to 505,595 tons at yearend 1987 or equivalent to a 6-month supply.

According to estimates by an industry source, production of metallic manganese by Toyo Soda Manufacturing Co. Ltd. and Chuo Denki Kogyo Co. Ltd. dropped to 3,700 tons from 3,900 tons in 1986 because of reduced consumption by the makers of specialty steel. However, consumption by the makers of nonferrous alloys is expected to increase in the future.

Nickel.—Japan continued to import 100% of its nickel requirements in 1987 in the form of nickel ore and matte, ferronickel, and refined nickel. Japan remained the world's third largest producer of ferronickel and nickel metal and was a major importer of nickel ore and matte and refined nickel. Because of a significant increase in domestic demand for nickel, imports of refined nickel surged to a record-high in 1987.

Imports of nickel ore for production of ferronickel rose slightly to 2,926,857 tons. Indonesia, New Caledonia, and the Philippines remained the three suppliers, accounting for 40%, 37%, and 23%, respectively. Imports of nickel matte for production of refined nickel and nickel oxide sinter decreased slightly to 53,567 tons, of which 62% was supplied by Indonesia and 38% by Australia.

Production of ferronickel increased slightly to 203,143 tons containing 49,405 tons of nickel, of which 50% was produced by Pacific Metals Co. Ltd.; 21% by Hyuga Smelting Co. Ltd., a subsidiary of Sumitomo Metal Mining; 20% by Nippon Yakin Kogyo Co. Ltd.; and 9% by Oita Nickel Co. Ltd., a subsidiary of Nippon Mining. In October, Nippon Mining shut down indefinitely its Oita nickel smelter at Saganoseki in Oita Prefecture of northeast Kyushu because of losses resulting from high costs of nickel ore and of energy and because of furnace problems. Nippon Mining took this action despite tight domestic and world market. The Oita smelter, capable of producing 9,600 tons per year of nickel content, produced 4,262 tons nickel in ferronickel for the first 9 months of 1987. To meet the domestic demand by the specialty steel industry, Japan also imported 29,935 tons of ferronickel in 1987, principally from New Cale-

donia, 44%, and the Dominican Republic, 31%.

Production of refined nickel declined 13%, due to closure of Nippon Mining's Nikko nickel plant at Hitachi in Ibaraki Prefecture in September 1986. Nickel refining in 1987 was by Sumitomo Metal Mining and Shimura Kako Co. Ltd. Production of nickel oxide sinter by Nippon Nickel Co. Ltd. and Tokyo Nickel Co. Ltd. remained at 19,000 tons in 1987. Tokyo Nickel was doubling the capacity to 32,000 tons per year at its Matsuzaka plant in Mie Prefecture. Upon completion of the expansion program in mid-1988, Tokyo Nickel reportedly will terminate its toll smelting agreement with Nippon Nickel.

Because of reduced domestic production and an unexpected stronger demand by the specialty steel, nonferrous alloy, and battery industries in the second half of 1987, imports of refined nickel including flakes, foil, powder, and wire rose sharply from 28,353 tons in 1986 to 46,085 tons. The principal suppliers in 1987 were the U.S.S.R., 10,643 tons; Canada, 9,651 tons; Zimbabwe, 6,016 tons; China, 5,074 tons; the United Kingdom, 3,977 tons; Australia, 3,866 tons; and Norway, 3,676 tons. Imports of refined nickel from China rose to more than 5,000 tons from 1,600 tons in 1986 and only 10 tons in 1985. According to Japanese sources, China produced 27,000 tons of refined nickel in 1987 and planned to double its nickel refining capacity at Jinchuan in Gansu Province to 40,000 tons per year in the next 2 to 3 years. By 1990, China could become an important supplier of refined nickel to Japan.

As a result of a tight supply in the world market, the average monthly nickel price on the London Metal Exchange rose from $1.62 per pound in December 1986 to $2.02 per pound in June and $3.48 per pound in December. However, because of the 14% appreciation in the yen in 1987, Japan's import c.i.f. price averaged $2.07 per pound compared with $1.96 per pound in 1986.

Consumption of refined nickel rose to 57,927 tons from 44,509 tons in 1986 owing mainly to a 44% rise in demand by the specialty steel industry. By major consumer, nickel consumption for specialty steel rose from 27,118 tons in 1986 to 39,064 tons; for plating, 5,938 tons to 6,047 tons; for nonferrous alloys, 3,218 tons to 3,671 tons; for magnetic materials, from 3,056 tons to 3,267 tons; and for storage batteries, 1,976 tons to 2,384 tons. Exports of refined nickel dropped 16% to 351 tons in 1987. However, the stocks held by producers, distributors, and consumers at yearend rose 12% to 15,255 tons or equivalent to a 3-month supply in 1987.

Rare Earths.—Japan was a major world consumer of rare earths, however, it relied on imports for all its rare-earth requirements. For the first time, MITI began publishing the combined production of 10 rare-earth commodities produced by 9 domestic companies that used imported raw material in 1987. Imports of rare earths included mainly rare-earth concentrates, crude rare earths, and separate rare-earth products. Consumption of rare-earth products in Japan covered a wide range of applications such as cerium oxide for polishing optical lenses, europium and yttrium oxides for color cathode ray tubes, lanthanum and neodymium oxides for ceramic condensers and optical lenses, and samarium and neodymium oxides for rare-earth magnets.

According to MITI, the combined output of cerium oxide, europium oxide, gadolinium oxide, lanthanum oxide, neodymium fluoride, neodymium oxide praseodymium oxide, samarium oxide, terbium oxide, and yttrium oxide was 3,053 tons. The nine producers were Mitsubishi Chemical Industries Ltd., MMSC, Nippon Yttrium Co. Ltd., Nissan Kigenso Co. Ltd., Santoku Kinzoku Kogyo Co. Ltd., Seimi Chemical Co. Ltd. Shi-Etsu Chemical Co. Ltd., Shin Nippon Kinzoku Kagaku Co. Ltd., and Tohoku Kinzoku Kagaku Co. Ltd.

In 1987, imports of rare-earth concentrate in the form of bastnasite, monazite, and xenotime totaled 2,330 tons, of which 862 tons was from China; 557 tons from the United States; 511 tons from Malaysia; and the remainder principally from India and other countries. Imports of crude rare earths totaled 3,752 tons, of which 1,497 tons was from China, 826 tons from the United States, 718 tons from India, 625 tons from Brazil, and 86 tons from Malaysia. Imports of rare-earth products were 331 tons of yttrium oxide, 258 tons of cerium oxide, 102 tons of lanthanum oxide, 278 tons of rare-earth metals, and 4,430 tons of rare-earth compounds. The principal suppliers were China for yttrium oxide, rare-earth metals, and rare-earth compounds; France for lanthanum oxide and rare-earth compounds; and the United States for cerium oxide and rare-earth compounds. Japan also imported from France 288 tons of neodym-

ium oxide, neodymium fluorides, and neodymium carbonate; 167 tons of samarium oxides, and 277 tons of cerium hydroxides.

According to Japan Chemical Week, the estimated demand for rare-earth products in 1987 were 380 tons for catalysts, 2,800 tons for cerium oxide, 10 tons for europium oxide, 360 tons for lanthanum oxide, 280 tons for mischmetal, 60 tons for rare-earth fluoride, 340 tons for samarium oxide, 240 tons for yttrium oxide, and 400 tons for other rare-earth oxides.[1]

To secure and diversify the supply sources of its growing demand for rare-earth minerals, MMAJ signed an agreement with the Department of Natural Resources of Kenya in July for a 3-year joint rare earths exploration project in a 10,000-square-kilometer area of Homabay, Kenya. Under a 5-year joint exploration agreement with China in 1986, MMAJ sent a team to China in October to explore for rare earths in southwestern Guangdong Province. Mitsubishi Corp. of Japan and the British Petroleum Co. of the United Kingdom reached an agreement with China in November to investigate rare-earth resources in Gansu, Sichuan, Yunnan, and Qinghai Provinces of China as well as in Tibet and the Xinjian autonomous region in West China. The joint investigation was scheduled to start in early 1988. In late 1987, Inoue Japan Research Inc. of Japan planned to collaborate with Beijing University and Shanghai Jiaotong University of China to conduct research on using rare earths in magnets and ceramic materials.

Tin.—Japan stopped tin mining when the Akenobe Mine in Hyogo Prefecture was shut down in February. The mine has been producing tin for the past 120 years. According to Mitsubishi Metal, its owner, the mine produced 238,000 tons of ore in 1986, averaging 0.34% tin, 1.37% copper, and 4.67% zinc. The mine was closed because of mounting losses resulting from low tin prices and the appreciation of the yen in 1987.

Despite a lack of domestic tin ore and concentrate, Mitsubishi Metal continued to produce tin metal at the Ikuno plant of its Naoshima copper-tin smelting and refining complex in Kagawa Prefecture of North Shikoku. The smelter reportedly used other residual materials and imported ore for crude tin production in 1987.

To meet domestic demand, Japan imported 31,997 tons of refined tin mainly from Malaysia, 53%; Thailand, 20%; Indonesia, 16%; and China, 8%. Domestic consumption of tin rose 3.5% to 32,620 tons, of which 42% was for silver solder, 31% for tinplate, 5% for electric wire and cable, 4% for brass mill products, and 18% for other. Japan exported only 87 tons of refined tin in 1987.

Titanium.—Japan continued to rely on imports for its raw material requirements mainly for producing titanium metal and oxide. In 1987, it imported 570,377 tons of titanium ore and concentrate and 88,387 tons of titanium slag. Australia was the supplier of rutile for sponge metal and ferrotitanium, while the Republic of South Africa was the supplier of titanium slag for oxide production. The principal suppliers of ilmenite for production of oxide and for refractory material in steelmaking were Australia, India, Malaysia, and Sri Lanka.

Despite a moderate improvement in exports, production of titanium sponge metal continued to move downward because of a high inventory, stagnant domestic demand, and further appreciation of the yen. According to the Japan Titanium Society, domestic demand for titanium sponge, including producer in-house consumption, was 9,586 tons compared with 9,556 tons (revised) in 1986 while exports rose 25.7% to 4,250 tons. In 1987, the major overseas buyers of titanium sponge metal were the United Kingdom, 1,593 tons; the United States, 960 tons; France, 765 tons; the Federal Republic of Germany, 569 tons; and the Netherlands, 283 tons.

Production of titanium dioxide pigment continued to increase owing to a steady growth in consumption by the paint and coating, printing ink, and paper manufacturing industries. According to the Japan Titanium Dioxide Industry Association, domestic demand for titanium dioxide was estimated at 165,990 tons compared with 162,738 tons in 1986. Domestic consumption by end user in 1986 was 85,451 tons for paint and coatings, 26,813 tons for printing ink, 14,215 tons for synthetic resin, 12,073 tons for paper manufacturing, 4,695 tons for chemical fibers, 3,869 tons for rubber, and 15,622 tons for other. Exports of titanium dioxide totaled 65,464 tons in 1986 and were estimated to be 66,780 tons in 1987.

In May, Ishihara Sangyo Kaisha Ltd. (ISK) started construction of its first overseas titanium dioxide plant in Singapore and established a wholly owned subsidiary, ISK Singapore Pte. Ltd. to operate the plant. JGC Corp. of Japan was selected as the prime contractor for the $100 million

phase-1 project to build a 36,000-ton-per-year titanium dioxide plant. Phase 1 was expected to be completed in mid-1989. The 100,000-ton-per-year ilmenite beneficiation plant at North Capel, Western Australia, where ISK has a 15% stake, was opened officially in February. Under a long-term agreement, the Australian plant will deliver 40% of its annual output to ISK's Singapore titanium dioxide plant, beginning in 1989.[16]

INDUSTRIAL MINERALS

Cement.—Despite a slight improvement in domestic demand, production moved lower. The higher yen has resulted in more imports of low-price foreign cement and less exports. According to the Cement Association of Japan (CAJ), the industry's production capacity was down to 98 million tons per year with only 41 plants operating. The industry's employment was reduced by 7% to 7,740. To survive competition from overseas, the industry reportedly would reduce its annual capacity by another 12 million tons with tax and other incentives to be offered by the Government in the next few years.

Exports of cement dropped 22% to 4.3 million tons while imports rose 70% to 2.5 million tons. The Republic of Korea and Taiwan remained the major sources of low-price imported cement. According to an industry source, foreign cement in September was $14 to $21 per ton cheaper than domestic cement in the Tokyo area. Cutbacks in construction in Saudi Arabia and Kuwait continued to affect exports. Since 1986, exports of cement went mostly to China, Hong Kong, Pakistan, Singapore, Sri Lanka, and the United States.

Consumption of cement rose slightly to 68.6 million tons compared with 67.7 million tons in 1986. According to CAJ, 69% was used for ready-mixed concrete; 16% for concrete products, 5% for civil engineering, 3% for building construction, and 7% for other.

Table 7.—Japan: Cement production in fiscal year 1986, by marketing group and company

(Thousand metric tons)

Group and company	
Andes Group:	
Aso Cement Co. Ltd	917
Denki Kagaku Kogyo Co. Ltd	2,058
Hachinohe Cement Co. Ltd	1,295
Kanda Cement Co. Ltd	1,153
Nittetsu Cement Co. Ltd	1,229
Sumitomo Cement Co. Ltd	7,475
Total	14,127
Central Group:	
Hitachi Cement Co. Ltd	974
Mitsui Mining Co. Ltd	1,815
Onoda Cement Co. Ltd	8,121
Shin Nittetsu Cement Co. Ltd	1,433
Tosoh Corp	2,119
Total	14,462
Dainippon Group:	
Daiichi Cement Co. Ltd	971
Myojo Cement Co. Ltd	1,392
Nihon Cement Co. Ltd	8,439
Osaka Cement Co. Ltd	3,723
Total	14,525
Fuji Group:	
Mitsubishi Mining and Cement Co. Ltd	7,838
Tokuyama Soda Co. Ltd	3,652
Total	11,490
Union Group:	
Chichibu Cement Co. Ltd	5,015
Ryukyu Cement Co. Ltd	474
Tsuruga Cement Co. Ltd	1,226
Ube Industries Ltd	7,525
Total	14,240
Tohoku Kaihatsu Co. Ltd	1,572
Grand total	70,416

Source: Industrial Minerals (London), No. 242, Nov. 1987, p. 37.

Fertilizer Materials.—The nitrogen fertilizer industry continued to suffer from lower domestic demand and increased imports. In fiscal year 1987, the industry reduced further its annual capacity of ammonia and urea from 2,303,000 tons to 2,249,600 tons and from 1,460,000 tons to 1,252,500 tons, respectively. According to the Japan Urea and Ammonium Sulfate Industry Association (JUASIA), in fiscal year 1987, the capacity utilization for ammonia and urea was 83% and 58%, respectively.

Production of ammonium sulfate declined slightly because of reduced consumption for high-analysis compound fertilizer while production of urea dropped considerably because of low market prices and increased imports. Imports of urea reportedly rose 150% to 247,000 tons and exports fell 44% to 59,000 tons in fiscal year 1987. The principal suppliers of urea were Qatar, 40%; Indonesia and Malaysia, 17% each; and the United States and the U.S.S.R., 8% each. Japan's supply and demand for ammonium sulfate, urea, and ammonium chloride, according to JUASIA, are shown in table 8.

Table 8.—Japan: Supply and demand for ammonium sulfate, urea, and ammonium chloride in fiscal year 1987

(Thousand metric tons)

	Ammonium sulfate	Urea	Ammonium chloride
Stocks, beginning	282	96	31
Production	1,787	721	358
Domstic demand:			
Fertilizer	1,117	208	255
Indutrial use	38	472	46
Exports	676	59	41
Stocks, ending	237	78	48

Source: Japan Chemical Annual, 1987.

In the phosphatic fertilizer industry, production of phosphoric acid declined 7% below 1986 to 455,000 tons because of increased imports of ammonium phosphate due to lower world market prices and further appreciation of the yen. To meet requirements for production of phosphoric acid, superphosphate of lime, fused phosphate, multicalcined phosphate, and other compound fertilizers, Japan imported 2.2 million tons of phosphate rock in 1987. The United States, Morocco, and Jordan remained the dominant suppliers accounting for 56%, 23%, and 14%, respectively.

Fluorspar.—Japan was the world's third largest consumer of fluorspar but lacks indigenous resources. Its fluorspar requirements for iron and steel and the fluorine compounds manufacturing industries were met by imports. Imports of fluorspar declined from 570,656 tons in 1985 to 527,545 tons in 1987 mainly because of reduced consumption of metallurgical-grade fluorspar by the iron and steel industry. Of the imports, 283,970 tons was metallurgical grade and 243,970 tons was acid grade. China supplied 384,970 tons, of which 51% was metallurgical grade and 49% was acid grade. Other major suppliers included Thailand, 63,652 tons of metallurgical-grade, and the Republic of South Africa, 47,299 tons of acid-grade fluorspar.

Limestone.—Japan remained the world's third largest limestone producer. Production of limestone rose slightly owing to stronger demand by the iron and steel and construction industries. The top 10 limestone quarries produced 40% of the total during 1986-87. The production by these quarries for 1986-87 is shown in table 9.

Table 9.—Japan: Limestone production of 10 leading quarries

(Thousand metric tons)

Company and mine location	1986	1987
Todaka Mining Co. Ltd.:		
Todaka-Tsukumi, Oita	9,368	9,762
Ube Industries Ltd.:		
Isa, Yamaguchi	10,389	9,561
Nittetsu Mining Co. Ltd.:		
Torigatayama, Kochi	8,891	8,623
Nittetsu-Tsukumi, Oita	4,607	4,772
Mitsubishi Mining and Cement Co. Ltd.:		
Higashitani, Fukuoka	6,783	7,114
Sumitomo Cement Co. Ltd.:		
Shuho, Yamaguchi	5,837	5,842
Onoda Cement Co. Ltd.:		
Onoda-Tsukumi, Oita	5,649	5,776
Onoda-Nagaiwa, Iwate	4,476	4,788
Sumimetal Mining Co. Ltd.:		
Hachinohe Limestone, Aomori	4,396	4,578
Mitsui Mining Co. Ltd:		
Sekinoyama, Fukuoka	4,435	4,422
Other producers	97,527	100,719
Total	162,358	165,957

Source: Limestone Association of Japan.

According to MITI, Japan consumed 167 million tons of limestone in 1987, of which 47% was for cement, 12% for iron and steel, 6% for lime, 29% for construction aggregate and other construction materials, 1% for soda and glass, and 5% for other.

MINERAL FUELS

Coal.—Japan began implementing its Eighth National Coal Policy in April. Under this new policy, Japan's coal production would be reduced to 10 million tons by 1991.

In May, Mitsui Coal Mining, Japan's largest coal mining company, decided to shut down the Sunagawa Mine in Hokkaido and scale down coal operations at the Miike Mine in Kyushu and the Ashibetsu Mine in Hokkaido. In July, Hokutan Mayachi Coal Mining also decided to close its Mayachi Mine in Hokkaido.

The Sunagawa Mine, capable of producing 1 million tons per year, officially ended coal mining on July 14 after 73 years of operation. According to Mitsui Coal Mining, in addition to having problems with methane gas, the mine was losing $14 for each ton of coal produced in 1986. Mitsui Coal Mining planned to gradually reduce its work force by 12% and cut annual production at the Miike Mine in Kyushu and the Ashibetsu Mine in Hokkaido from 4.5 million to 3.5 million tons and 950,000 to 500,000 tons, respectively, by 1990. Because of financial difficulties, Hokutan Mayachi Coal Mining officially ended its coal operations in October and dismissed all 934 workers. The Mayachi Mine had an annual capacity of 700,000 tons.

As a result of mine closures by Mitsui Coal Mining and Hokutan Mayachi Coal Mining in 1987, domestic coal production by the remaining 9 major coal mines and 15 small- and medium-size mines dropped by 3 million to 13 million tons. Of this total, 62% was from the Hokkaido area and 38% was from the Kyushu area; 12% was coking coal, and 88% was anthracite and other bituminous coal. The average heating value of the Japanese coal was 6,030 kilocalories per kilogram in 1987. The industry's employment at yearend declined to 9,167 from 12,906 in 1986. However, labor productivity increased to 100 tons of coal per month per miner from 96 tons of coal per month per miner in 1986. The working days per miner declined to 288 from 296 in 1986. In 1987, domestic coal production was equivalent to 12.5% of domestic consumption.

To meet domestic demand, Japan imported 90.9 million tons of coal in 1987, of which 63.9 million tons was coking coal, 25.4 million tons was steam coal, and 1.6 million tons was anthracite. Coking coal was imported principally from Australia, 45%; Canada, 24%; the United States, 14%; the U.S.S.R., 8%; the Republic of South Africa, 6%; and China, 3%. Other bituminous coal for power generation was imported mainly from Australia, 71%; the Republic of South Africa, 10%; China and the United States, 9% each. Anthracite was imported principally from the Republic of South Africa, 39%; Australia, 14%; and China, 12%.

According to the Ministry of Finance, the average import c.i.f. price per ton of coking coal in 1987 from Australia was $48; Canada, $65; the United States, $64; the U.S.S.R., $48; the Republic of South Africa, $43; and China, $43. The average import c.i.f. price per ton of bituminous coal for power generation in 1987 from Australia and the Republic of South Africa was $42; China, $38; and the United States, $47.

Despite a stronger demand by the cement, ceramics, and electric power industries, the overall demand for coal dropped 2% below 1986 because of reduced consumption by the coke and iron and steel industries. According to MITI, coal consumption by sector was as shown in table 10.

Table 10.—Japan: Coal consumption, by sector

(Thousand metric tons)

Sector	1986[r]	1987
Manufacturing:		
Cement, ceramics, other:		
Domestic	1,497	897
Imported	10,654	13,168
Coke:		
Domestic	621	217
Imported	4,908	4,652
Iron and steel:		
Domestic	1,964	611
Imported	60,859	58,753
Utilities:		
Electric power:		
Domestic	9,335	9,442
Imported	13,300	13,693
Gas:		
Domestic	281	284
Imported	731	544
Other:		
Domestic	1,643	1,283
Imported	10	49
Total demand	105,800	103,593
Of which:		
Domestic	15,338	12,734
Imported	90,462	90,859

[r]Revised.

Source: Ministry of International Trade and Industry, Japan.

Petroleum and Natural Gas.—Domestic production of crude petroleum averaged 12,200 barrels per day compared with 12,683 barrels per day in 1986, while production of natural gas averaged 210 million cubic feet per day compared with 204 million cubic feet per day in 1986. Domestic production was equivalent to 0.4% and 4.7% of Japan's requirements for crude petroleum and natural gas, respectively, in 1987.

Japan remained the second largest importer of crude petroleum and the largest importer of natural gas in the world. De-

spite the higher yen, imports of crude petroleum declined further by 5% to 1,116 million barrels because of reduced consumption by domestic oil refineries resulting from further production cutbacks in kerosene, naphtha, and type C heavy fuel oil. However, because of increased demand for power generation for heating and cooking, imports of natural gas, in the form of LNG, rose 3% over 1986 and reached another record high of 29.2 million tons.

Because of tension in the Persian Gulf, the share of crude petroleum imports from the Middle East dropped further to 67% from 69% in 1986 while the share from Asia, including China, rose to 26% from 24% in 1986. The United Arab Emirates, Saudi Arabia, Indonesia, and China remained the dominant suppliers to Japan, accounting for 19%, 18%, 14%, and 8% of the imports, respectively. Other important suppliers included Iran and Oman, 7% each; Kuwait, 6%; and Mexico, 5%. Imports of LNG from Indonesia were 15.0 million tons; Malaysia, 5.9 million tons; Brunei, 5.2 million tons; the United Arab Emirates, 2.2 million tons; and the United States, 900,000 tons.

Consumption of crude petroleum by the oil refinery industry dropped 2.7% to 2.9 million barrels per day. The industry also reduced its refining capacity by 4.2% to 4.8 million barrels per day in 1987. The industry's average capacity utilization increased slightly to 61.1% compared with 59.9% in 1986. According to an industry source, the refinery industry was expected to trim capacity by 700,000 barrels per day by 1988. To improve efficiency and upgrade the facilities, more secondary-processing facilities would be built to increase production of lighter refined products.

In June, a report on deregulating and restructuring the Japanese petroleum industry was completed by a private advisory committee called the Petroleum Committee of the Petroleum Council. The report recommended to MITI that restructuring through relaxation of Government regulations on production and marketing activities should increase competition among the oil companies. However, it said domestic refineries should continue to be protected from foreign competition. Only domestic refiners were allowed to import refined products.[17]

Imports of refined petroleum products rose sharply because of cutbacks in domestic production of diesel fuel, kerosene, and naphtha. In 1987, imports of diesel fuel rose 353% to 25.4 million barrels, gasoline rose 27% to 26.4 million barrels, kerosene rose 127% to 37.8 million barrels, and naphtha rose 16% to 126 million barrels. Imports as a percentage of domestic consumption of these products were 14% for diesel fuel, 11% for gasoline, 24% for kerosene, and 73% for naphtha.

The principal suppliers of refined petroleum products, in order of value, include Indonesia and Kuwait for naptha; Singapore for gasoline, kerosene, and naphtha; Saudi Arabia for diesel fuel, kerosene, and naphtha; the United Arab Emirates for kerosene and naphtha; and the United States for gasoline and diesel fuel.

In November, MITI announced that beginning in April 1988 it intended to triple taxes on imported oil to finance the national oil stockpile program. The new taxes would be based on volume rather than on value, which has been the basis in the past. To cope with an unstable oil supply in the world market, Japan planned to double its national oil stockpile from 151 million barrels to 314 million barrels by mid-1990. Japan's crude petroleum stockpile at the yearend totaled 483 million barrels, representing a 143-day supply. 153 million barrels were in the national stockpile and the remainder in private stockpiles. According to MITI, the tax changes were necessary because of the declining volume of crude petroleum imports and increasing value of the yen, both lowering the tax base.

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[1]Economist, Division of International Minerals.
[2]Journal of the Mining and Metallurgical Institute of Japan (Tokyo). V. 104, No. 1201, Mar. 1988, p. 6.
[3]Where appropriate, values have been converted from Japanese yen (Y) to U.S. dollars at the rate of Y144.64=US$1.00 for 1987.
[4]U.S. Embassy, Tokyo. State Dep. Telegram 12827, July 22, 1987.
[5]———. State Dep. Telegram 02843, Feb. 18, 1988.
[6]Sumitomo Corp. (Tokyo). Nonferrous Metals in Japan. No. 79, Mar. 1988, p. 62.
[7]Japan Metal Journal (Tokyo). V. 17, No. 25, June 22, 1987, p. 1; v. 17, No. 36, Sept. 7, 1987, p. 1.
[8]U.S. Embassy, Tokyo. State Dep. Telegram 15093, Aug. 25, 1987.
[9]Mining Magazine (London). V. 157, No. 7, Dec. 1987, p. 521.
[10]Page 5 of work cited in footnote 6.
[11]The Rare Metal News (Tokyo). No. 1407, June 24, 1987, p. 3.
[12]———. No. 1389, Feb. 8, 1987, p. 4.
[13]Mining Journal (London). V. 309, No. 7941, Oct. 30, 1987, p. 346.
[14]Far Eastern Economic Review (Hong Kong). V. 138, No. 52, Dec. 24, 1987, p. 62.
[15]Japan Chemical Week (Tokyo). V. 29, No. 1449, Jan. 1988, p. 10.
[16]Industrial Minerals (London). No. 237, June 1987, p. 11.
[17]U.S. Embassy, Tokyo. State Dep. Telegram 11261, June 26, 1987.

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